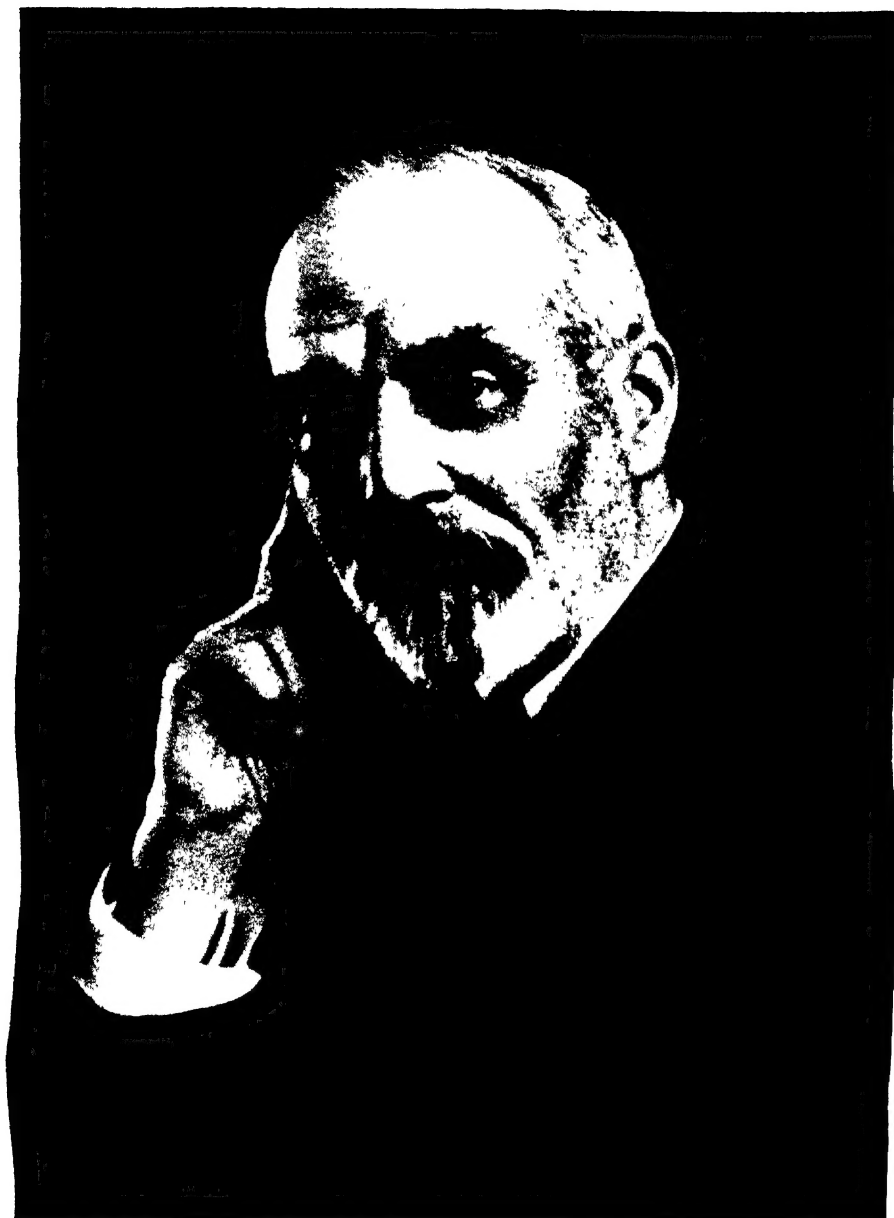


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PUZZLES
AND CURIOUS PROBLEMS

.



Henry J. Duclaux

PUZZLES AND CURIOUS PROBLEMS

BY

HENRY ERNEST DUDENEY

AUTHOR OF "THE CANTERBURY PUZZLES"

"AMUSEMENTS IN MATHEMATICS," ETC.

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NOTE

NUMEROUS requests from Mr. Dudeney's followers all over the world have encouraged us to put together an entirely new collection of some of his best work. We have tried, as was Mr. Dudeney's habit, to present the puzzles in a manner that may attract the reader who has only an elementary acquaintance with Mathematics, and at the same time to make them acceptable to those learned in the science.

We have to express our thanks to the *Daily News* and the *Strand Magazine* for allowing us to reprint puzzles that have appeared in their respective pages, and to the *Strand Magazine* for the loan of metal blocks.

ALICE DUDENEY.

PREFACE

MR. DUDENEY was born at Mayfield on April 10, 1857, and he died in the Castle Precincts, Lewes, on April 24, 1931.

He came of a very old Sussex family, and was especially proud of the fact that he had—as a collateral ancestor—John Dudeney, the famous shepherd mathematician. He, in the late eighteenth century, taught himself mathematics while leading his sheep on the Downs above Lewes; hiding the books, which he bought out of his small wages, in a hole on Newmarket Hill. He afterwards became a schoolmaster in the county town, and he is included in Lower's book, *Sussex Worthies*.

Before his mathematical work, and the immense correspondence it brought him, absorbed all his energies, Mr. Dudeney, who was a versatile man, had many hobbies and recreations.

He was a brilliant pianist and organist. When living in London he was honorary organist of more than one church, at different times; and, as choirmaster, trained his choir in plainsong, the ancient music. From youth till death he was a faithful Churchman. He was also interested and skilled in religious controversy, and had written more than one tract defending the Catholic position of the English Church.

He was naturally fond of, and skilled at games, although he cared comparatively little for cards. He was a good chess player, and a better problemist. As a young man he was fond of billiards, and also played croquet well. As an old man, and up to the time of his last illness, he every evening, through the season, played bowls upon the old bowling green within the Castle Precincts.

He was admittedly the greatest puzzlist of the age, and he made his first appearance as a mathematician in *Tit-Bits*, and later on in the *Weekly Dispatch* and *Strand Magazine*. He has also published three works dealing with mathematics—*Amusements in Mathematics*, *The Canterbury Puzzles*, and *Modern Puzzles*.

The object of the present introduction is to show that he must for ever remain a noted authority in many branches of the subject. Had he entered for the teaching profession he would have made an excellent teacher, for what Mr. Silvanus Thompson has done for the Calculus in his epoch-making book, *Calculus Made Easy*, Mr.

Dudeney has done for Mathematics in general, as he has covered a wide range in mathematical branches, and is at home in them all.

A mathematician must have three great qualifications—a knowledge of the subject, ability and facility of explanation, and the power to make the subject both interesting and simple. It is our chief aim to select material from his works in order to give the reader some idea of his wonderful ability.

He was the first mathematician to deal with the "digital roots" of numbers, and his problem No. 951 in the *Strand Magazine* drew from Mr. Rouse Ball the following remarks: "This application is *original* on Mr. Dudeney's part. Digital properties are but little known to mathematicians, and we hope the example of Mr. Dudeney will serve to direct attention to it."

Mr. Dudeney next entered on the field of Geodesics, and his original problem of "The Spider and the Fly," first appearing in the *Daily Mail* on February 1, 1905, created a sensation. The reader who wishes for a full account of the problem should see the solution in *The Canterbury Puzzles*. Another problem on similar lines, "The Fly and the Honey," No. 162 in *Modern Puzzles*, is both neat and interesting, and the "Nelson Column," No. 98 in *The Canterbury Puzzles*, should be read in conjunction with this. Another famous problem tackled by Mr. Dudeney is called the "Josephus" problem. It is given in the present volume under the heading "Pat in Africa," and appeared also in *Tit-Bits* on October 14, 1905. The fact that Mr. Dudeney knew, though he never published, the general solution to this class of problem and its variants, is an achievement of no mean order.

In the realm of Permutations and Combinations he is well to the front. His general solution to the difficult classes of ring arrangements speaks highly of his ability, and it is a great pity that he did not publish his rules on a certain particular class of these problems, for it would be difficult—if not impossible—to find to-day a mathematician able to furnish it. (See *Canterbury Puzzles*, No. 90.)

How many people are aware that there is no general formula for expressing all prime numbers? Yet Mr. Dudeney has made us all familiar with the particular problem formula, $x^2 + x + 41$, which gives us prime numbers for any integral value of x up to 40, and his problem of "The Banker's Puzzle," No. 134 in *Amusements in Mathematics*, gets the truth home to us in a most interesting fashion. The fact that Mr. Dudeney was the first to note that magic squares composed entirely of prime numbers can be constructed, must also be recorded.

Mathematical fallacies are just as interesting as mathematical truths, and Euclid wrote a book on the subject, but the work is lost. Mr. Dudeney has presented us with a good few of these, notably the very neat and interesting and original one in *The Canterbury Puzzles*, page 26.

Now let us take a selection of Mr. Dudeney's problems and see where they lead us. In "Pat and his Pig" perplexity, No. 210 in present volume, we are introduced to the difficult curve of Pursuit, and it is noteworthy that this is the only class of curved line whose length can be found exactly. We will strain a point to give the reader an easy method by which the length of this curve may be found. If the pig's speed be taken as unity, and Pat's speed as n times as great,

and a the distance separating them at the start, then the length of Pat's curve is given by $\frac{an^2}{n^2 - 1}$.

In the "Excursion Ticket" problem in *Amusements in Mathematics*, we are presented with the difficult problem of giving change; and what is more important, Mr. Dudeney possessed the general formulæ for the solution of such problems. In the "Four Princes" we meet the difficult problem that defeated the late Lewis Carroll—viz., to find four right-angled Δ 's of equal area. In the "Dispatch Rider in Flanders," and in "Economy in String," we have calculus problems on Maxima and Minima.

In the year 1905 Mr. Dudeney exhibited before the Royal Society, and also at the Royal Institution, a model of his most famous, but certainly not his greatest, problem. The problem was to divide an equilateral triangle into four pieces, so that they would fit together to form a perfect square of equal area to the triangle. The solution, as one sees it in *The Canterbury Puzzles*, is both neat and ingenious, and furthermore it has the merit of being original, which is more than can be said of several other dissection problems. This same problem was issued as a challenge to the readers of the *Daily Mail*, and it is worthy of note that, although hundreds of attempts were sent in, not a single correct solution was received. The lovely model in mahogany, showing the four pieces linked together so as to form either the triangle or the square, is a fitting setting to such a neat and highly ingenious problem. But Mr. Dudeney is unique in the science of dissection problems, and his solutions, showing how many of the regular polygons may be divided into the fewest pieces to form the corresponding squares, are both interesting and instructive, and display in a great measure his unquestioned mathematical ability. It is remarkable that the regular octagon can be cut into as few as four pieces to form the corresponding square.

Mr. Dudeney has frequently scored a point over the past mathematicians, notably Fermet, Legendre, Barlow, and it is certainly no mean achievement to beat the brilliant expert in the theory of numbers on his own ground.

It is stated that Kirkman became famous by his "Fifteen Schoolgirl" problem, but in Mr. Dudeney's case the difficulty is to find a problem in which he is not famous. In Rouse Ball's *Mathematical Recreations* Mr. Dudeney's name occurs nine times, and in many of these references he stands alone in the field. His methods of bringing his mathematical genius before the public are both interesting and instructive, and results of a high order in mathematics are brought under our notice in a way that is certain to spur us on to greater efforts in order to get a deeper insight into the workings of his mathematical ability. In this connection mention must be made of "The Four Princes," "Pat and his Pig," "The Excursion Ticket," "The Spider and the Fly," "The Doctor of Physic," "Making a Pentagon," "The Haberdasher's Puzzle" which was exhibited before the Royal Society, and many others more important than even the above. He also made history in the "Mathematical Reprints" of the *Educational Times*, notably in Vols. XIV., XV., and XVII., and in the *Monist* for his contribution on "Magic Squares of Prime Numbers." It is also a noteworthy achievement, the splendid

article he wrote on " Magic Squares " in the latest edition of the *Encyclopædia Britannica*, an article displaying his extraordinary grasp of this complicated subject.

I am grateful to Mr. James Travers, B.A., B.Sc., M.R.S.T., Headmaster, Peterboro' College, Harrow, who for the last decade of my husband's life was in frequent correspondence with him, for his kindness in supplying the mathematical notes embodied in this brief memoir, and also for correcting the proofs.

Alice Dudeney.

CASTLE PRECINCTS HOUSE,
LEWES,
December 1931.

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ARITHMETICAL AND ALGEBRAICAL PROBLEMS

PUZZLES AND CURIOUS PROBLEMS

ARITHMETICAL AND ALGEBRAICAL PROBLEMS

MONEY PUZZLES

1.—THE MONEY BAG

'A BAG,' said Rackbrane, when helping himself to the marmalade, "contained fifty-five coins consisting entirely of crowns and shillings, and their total value was £7, 3s. 0d. How many coins were there of each kind?"

2.—A LEGACY PUZZLE

A MAN left legacies to his three sons and to a hospital, amounting in all to £1,320. If he had left the hospital legacy also to his first son, that son would have received as much as the other two sons together. If he had left it to his second son, he would have received twice as much as the other two sons together. If he had left the hospital legacy to his third son, he would have received then thrice as much as the first son and second son together. Find the amount of each legacy.

3.—BUYING TOYS

GEORGE and William were sent out to buy toys for the family Christmas tree, and, unknown to each other, both went at different times to the same little shop, where they had sold all their stock of small toys except engines at 4d., balls at 3d. each, dolls at 2d. each, and trumpets at ½d. each. They both bought some of all, and obtained 21 articles, spending 2s. each. But William bought more trumpets than George. What were their purchases?

4.—PUZZLING LEGACIES

A MAN bequeathed a sum of money, a little less than £1,500, to be divided as follows: The five children and the lawyer received such sums that the square root of the eldest son's share, the second son's share divided by two, the third son's share minus £2, the fourth son's share plus £2, the daughter's share multiplied by two, and the square of the

lawyer's fee all worked out at exactly the same sum of money. No pounds were divided, and no money was left over after the division. What was the total amount bequeathed ?

5.—DIVIDING THE LEGACY

A MAN left £100 to be divided between his two sons Alfred and Benjamin. If one-third of Alfred's legacy be taken from one-fourth of Benjamin's, the remainder would be £11. What was the amount of each legacy ?

5.—A NEW PARTNER

Two partners named Smugg and Williamson have decided to take a Mr. Rogers into partnership. Smugg has one and a half times as much capital invested in the business as Williamson, and Rogers has to pay down £2,500, which sum shall be divided between Smugg and Williamson, so that the three partners shall have an equal interest in the business. How shall the sum be divided ?

7.—SQUARING POCKET-MONEY

A MAN has four different English coins in his pocket, and their sum in pence was a square number. He spent one of the coins, and the sum of the remainder in shillings was a square number. He then spent one of the three, and the sum of the other two in pence was a square number. And when he deducted the number of farthings in one of them from the number of halfpennies in the other, the re-

mainder was a square number. What were the coins ?

8.—EQUAL VALUES

A LADY and her daughter set out on a walk the other day, and happened to notice that they both had money of the same value in their purses, consisting of three coins each, and all six coins different. During the afternoon they made slight purchases, and on returning home found that they again had similar value in their purses made up of three coins each, and all six different. How much money did they set out with, and what was the value of their purchases ?

9.—POCKET-MONEY

" WHEN I got to the station this morning," said Harold Tompkins, at his club, " I found I was short of cash. I spent just one-half of what I had on my railway ticket, and then bought a penny newspaper. When I got to the terminus I spent half of what I had left and twopence more on a telegram. Then I spent half of the remainder on a bus, and gave threepence to that old match-seller outside the club. Consequently I arrive here with this single penny. Now, how much did I start out with ? "

10.—MENTAL ARITHMETIC

If a tobacconist offers a cigar at $7\frac{1}{4}d.$, but says we can have the box of 100 for 65s., shall we save much by buying the box ? In other words, what would 100 at $7\frac{1}{4}d.$ each cost ? By a little rule that we

shall give the calculation takes only a few moments.

11.—DISTRIBUTION

NINE persons in a party, A, B, C, D, E, F, G, H, K, did as follows: First A gave each of the others as much money as he (the receiver) already held; then B did the same; then C; and so on to the last, K giving to each of the other eight persons the amount the receiver then held. Then it was found that each of the nine persons held the same amount. Can you find the smallest amount in pence that each person could have originally held?

12.—REDUCTIONS IN PRICE

"I have often been mystified," said Colonel Crackham, "at the startling reductions some people make in their prices, and wondered on what principle they went to work. For example, a man offered me a motor-car two years ago for £512; a year later his price was £320; a little while after he asked a level £200; and last week he was willing to sell for £125. The next time he reduces I shall buy. At what price shall I purchase if he makes a consistent reduction?"

13.—THE THREE HOSPITALS

COLONEL CRACKHAM said that a hospital collection brought in the following contributions: A cheque for £2, 10s., two cheques for £1, 5s. each, three £1 Treasury notes, three 10s. Treasury notes, two crowns, two postal orders for 3s.

(3,646)

each, two florins, and three shillings. As this money had to be divided amongst three hospitals, just as it stood, since nobody happened to have any change in his pocket, how was it to be done?

14.—HORSES AND BULLOCKS

A DEALER bought a number of horses at £17, 4s. each, and a number of bullocks at £13, 5s. each. He then discovered that the horses had cost him in all 33s. more than the bullocks. Now, what is the smallest number of each that he must have bought?

15.—BUYING TURKEYS

A MAN bought a number of turkeys at a cost of £60, and after reserving fifteen of the birds he sold the remainder for £54, thus gaining 2s. a head by these. How many turkeys did he buy?

16.—THE THRIFTY GROCER

A GROCER in a small way of business had managed to put aside (apart from his legitimate profits) a little sum in £1 notes, 10s. notes, and crowns, which he kept in eight bags, there being the same number of crowns and of each kind of note in every bag. One night he decided to put the money into only seven bags, again with the same number of each kind of currency in every bag. And the following night he further reduced the number of bags to six, again putting the same number of each kind of note and of crowns in every bag. The next night the poor demented miser

tried to do the same with five bags, but after hours of trial he utterly failed, had a fit, and died, greatly respected by his neighbours. What is the smallest possible amount of money he had put aside ?

17.—THE MISSING PENNY

HERE is an ancient puzzle that has always perplexed some people. Two market women were selling their apples, one at three a penny and the other at two a penny. One day they were both called away when each had thirty apples unsold : these they handed to a friend to sell at five for twopence. Now it will be seen that if they had sold their apples separately they would have fetched 2s. 1d., but when they were sold together they fetched only 2s.

"Now," people ask, "what in the world has become of that missing penny ?" because, it is said, three for 1d. and two for 1d. is surely exactly the same as five for 2d.

Can you explain the little mystery ?

18.—THE RED DEATH LEAGUE

THE RED DEATH LEAGUE



THE police, when making a raid on the headquarters of a secret society, secured a scrap of paper similar to the above.

"Now, that piece of paper," said the detective, throwing it on the table, "has

worried me for two or three days. You see it gives the total of the subscriptions for the present year as £313, 5s. 4½d., but the number of members (I know it is under 500) and the amount of the subscription have been obliterated. How many members were there in the Red Death League, and what was the uniform subscription ?" Of course, no fraction of a farthing is permitted.

19.—A POULTRY POSER

THREE chickens and one duck sold for as much as two geese ; one chicken, two ducks, and three geese were sold together for 25s. What was the price of each bird in an exact number of shillings ?

20.—BOYS AND GIRLS

NINE boys and three girls agreed to share equally their pocket-money. Every boy gave an equal sum to every girl, and every girl gave another equal sum to every boy. Every child then possessed exactly the same amount. What was the smallest possible amount that each then possessed ?

21.—THE COST OF A SUIT

"HALLO, old chap," cried Russell as Henry Melville came into the club arrayed in a startling new tweed suit, "have you been successful in the card-room lately ? No ? Then why these fine feathers ?"

"Oh, I just dropped into my tailor's the other day," he explained, "and this cloth took my fancy. Here is a little

puzzle for you. The coat cost as much as the trousers and vest. The coat and two pairs of trousers would cost £7, 17s. 6d. The trousers and two vests would cost £4, 10s. Can you tell me the cost of the suit ? "

22.—THE WAR HORSE

" Yes," said Farmer Wurzel, " I sold one horse to the army. He cost me £13, but after paying for his keep I let the military people have him for £30."

" Then you made a nice little profit ? "

" Profit ! " exclaimed the farmer indignantly. " I lost just half the price I paid for the horse and one-quarter of the cost of his keep."

Now, how much did Wurzel lose on this patriotic transaction ?

23.—A DEAL IN CUCUMBERS

" How much do you pay for those cucumbers ? " asked the inquisitive visitor.

" Well," was the artful reply, " I pay just as many shillings for six dozen cucumbers of that size as I get cucumbers for 32s."

What was the price per cucumber ?

24.—THE TWO TURKEYS

" I SOLD them two turkeys I was speakin' to you about, Henery," said old Tozer to Henry Hobbs. " They weighed 20 lbs. together. Mrs. Burkett bought the large 'un for twenty-four shillin' and eightpence, and Mrs. Suggs paid six and ten for the little 'un. I made twopence a pound more on the little 'un than what I did on the other."

" Well, what did the big 'un weigh, Tozer ? "

" I cannot 'zactly remember, but you can work it out for yourself."

25.—FLOORING FIGURES

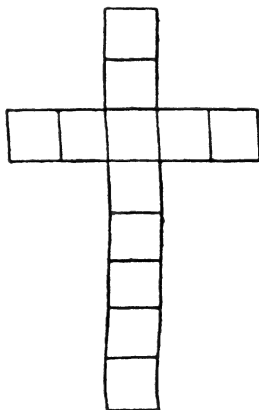
An African correspondent writes concerning a little curiosity which he has accidentally discovered in making out an invoice with the items :

148 ft. flooring boards at 2d. £1, 4s. 8d.

150 ft. flooring boards at 2d. £1, 5s. 0d.

where it will be seen that in each case the three figures are repeated in the same order. He thought this coincidence so extraordinary that he tried to find another similar case. This seems to have floored him, and readers may like to attempt a solution. I will say that it is possible. You may increase the number of pence if you like, but not use fractions of a penny.

26.—CROSS AND COINS



There is an interesting little puzzle that will probably keep the reader amused

for some moments. Take any eleven of the twelve current coins of the realm, and using one duplicate coin, can you place the twelve coins, one in each division of the cross, so that they add up to the same value in the upright and in the horizontal ?

To prevent any possible misunderstanding, the twelve current coins are of the value of £1, 10s., 5s., 4s., 2s. 6d., 2s., 1s., 6d., 3d., 1d., $\frac{1}{2}$ d., $\frac{1}{4}$ d. Now, remember, there must be eleven coins all of different value and only one duplicate. You see, the puzzle is to determine which coin we shall duplicate, and then so to arrange them that both rows shall add up alike when the question arises which coin shall be placed at the crossing to be twice added ?

27.—BUYING TOBACCO

"Try one of these cigarettes," said Wilson to his friend Watson over the last cup of breakfast coffee. Watson found it a very good one, and said—

"What did these cost you, old fellow ?"

"Well, I was just going to tell you," said Wilson, "that the box of fifty cigarettes cost the same in shillings and pence as the tobacco I bought at the same time cost in pence and shillings. And the change out of a ten-shilling note was the same as the cost of the cigarettes. Now, what did the cigarettes cost me ?"

28.—A FARTHING'S PUZZLE

"Now, George," said Colonel Crackham one morning, "see if you can find a sum

of money in pounds, shillings, and pence (all represented) that can be reduced to farthings by simply removing the dots that separate the shillings from the pounds, and the pence from the shillings."

George succeeded in finding £10, 10s. 7d., which is very near, as it reduces to 10,108 farthings, which is only a farthing out. Can you find the exact figures ?

29.—THE SHOPKEEPER'S PUZZLE

A SHOPKEEPER, for private marking, selects a word of ten letters (all different) such as NIGHTMARES, where each letter stands for one of the figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, in their order. So NI/ stands for 12s., and 7s. 6d. would be AM/. Assuming this little addition sum is in such a private code, can you find the man's key-word ? It is not

G A U N T
O I L E R

30.—SUBSCRIPTIONS

SEVEN men agreed to subscribe towards a certain fund, and the first six gave £10 each. The other man gave £3 more than the average of the seven. What amount did the seventh man subscribe ?

31.—A QUEER SETTLING UP

PROFESSOR RACKBRANE told his family at the breakfast table that he had heard

the following conversation in a railway carriage the night before. One passenger said to another, "Here is my purse: give me just as much money, Richard, as you find in it." Richard counted the money, added an equal value from his own pocket, and replied, "Now, John, if you give me as much as I have left of my own we shall be square." John did so, and then stated that his own purse contained three shillings and sixpence, while Richard said that he now had three shillings. How much did each man possess at first?

32.—APPLE TRANSACTIONS

A MAN was asked what price per 100 he paid for some apples, and his reply was as follows: "If they had been 4*d.* more per 100 I should have got five less for 10*s.*" Can you say what was the price per 100?

33.—PROSPEROUS BUSINESS

A MAN started business with a capital of £2,000, and increased his wealth by 50 per cent. every three years. How much did he possess at the expiration of eighteen years?

34.—THE BANKER AND THE NOTE

A BANKER in a country town was walking down the street when he saw a five-pound note on the kerb-stone. He picked it up, noted the number, and went to his private house for luncheon. His wife said that the butcher had sent in his bill for five pounds, and, as the only money he had was the note he had

found, he gave it to her, and she paid the butcher. The butcher paid it to a farmer in buying a calf, the farmer paid it to a merchant who in turn paid it to a laundry-woman, and she, remembering that she owed the bank five pounds, went there and paid the note. The banker recognized the note as the one he had found, and by that time it had paid twenty-five pounds' worth of debts. On careful examination he discovered that the note was counterfeit. Now, what was lost in the whole transaction, and by whom?

35.—THE REAPERS' PUZZLE

THREE men were to receive 90*s.* for harvesting a field, conditionally upon the work being done in five days. Jake could do it alone in nine days, but as Ben was not so good a workman they were compelled to engage Bill for two days, in consequence of which Ben got 35. 9*d.* less than he would otherwise have received. How long would it have taken Ben and Bill together to complete the work?

36.—THE FLAGONS OF WINE

A QUART of Burgundy costs 4*s.* 9*d.*, but 3*d.* is returnable on the empty flagon,

4*s.* 6*d.* For twelve of the capsules with which each of the quart flagons is sealed, a free flagon of the same wine can be obtained. What is the value of a single capsule? Obviously a twelfth of 4*s.* 6*d.*, which is 4½*d.* But the free flagon also has a capsule worth 4½*d.*, so that this full flagon appears to be worth

4s. $10\frac{1}{2}d.$, which makes the capsule worth a twelfth of 4s. $10\frac{1}{2}d.$, or $4\frac{1}{2}$, and so on *ad infinitum*, with an ever-increasing value. Where is the fallacy, and what is the real worth of a capsule?

37.—A WAGES PARADOX

"I WANT a rise, sir," said the office boy.

"That's nonsense," said the employer.

"If I give you a rise you will really be getting less wages per week than you are getting now."

The boy pondered over this, but was unable to see how such a thing could happen. Can you explain it?

AGE AND KINSHIP PUZZLES

38.—THE PICNIC

FOUR married couples had a picnic together, and their refreshments included thirty-two bottles of lemonade. Mary only disposed of one bottle, Anne had two, Jane swallowed the contents of three, and Elizabeth emptied four bottles. The husbands were more thirsty, except John MacGregor, who drank the same quantity as his better half. Lloyd Jones drank twice as much as his wife, William Smith three times as much as his wife, and Patrick Dolan four times as much as his wife demanded. The puzzle is to find the surnames of the ladies. Which man was married to which woman?

39.—SURPRISING RELATIONSHIP

ANGELINA. "You say that Mr. Tomkins is your uncle!"

EDWIN. "Yes, and I am his uncle!"

ANGELINA. "Then—let me see—you must be nephew to each other, of course! Funny, isn't it?"

Can you say quite simply how this might be, without any breach of the marriage law or disregard of the Table of Affinity?

40.—AN EPITAPH (A.D. 1538)

Two grandmothers, with their two granddaughters;

Two husbands, with their two wives;

Two fathers, with their two daughters;

Two mothers, with their two sons;

Two maidens, with their two mothers;

Two sisters, with their two brothers;

Yet only six in all lie buried here;

All born legitimate, from incest clear.

How might this happen?

41.—ANCIENT PROBLEM

HERE is an example of the sort of "Breakfast-time Problem" propounded by Metrodorus in A.D. 310.

Demochares has lived one-fourth of his life as a boy; one-fifth as a youth; one-third as a man; and has spent thirteen years in his dotage. How old is the gentleman?

42.—FAMILY AGES

A MAN and his wife had three children, John, Ben, and Mary, and the differ-

the same as between John and Ben and between Ben and Mary. The ages of John and Ben, multiplied together,

equalled the age of the father, and the ages of Ben and Mary multiplied together equalled the age of the mother. The combined ages of the family amounted to ninety years. What was the age of each person ?

43.—MIKE'S AGE

"PAT O'CONNOR," said Colonel Crackham, "is now just one and one-third times as old as he was when he built the pig-sty under his drawing-room window."

"Why on earth," asked Dora, "did he build it under his drawing-room window ?"

"To keep the pigs in, of course. Start again."

"Pat is now just one and one-third times as old as he was when he built the sty, and little Mike, who was forty months old when Pat built the sty, is now two years more than half as old as Pat's wife, Biddy, was when Pat built the sty, so that when little Mike is as old as Pat was when he built the sty, their three ages combined will amount to just one hundred years. How old is little Mike ?"

44.—THEIR AGES

RACKBRANE said the other morning that a man on being asked the ages of his two sons stated that eighteen more than the sum of their ages is double the age of the elder, and six less than the difference of their ages is the age of the younger. What are their ages ?

45.—BROTHER AND SISTER

A BOY on being asked the age of himself and of his sister replied :

"Three years ago I was seven times as old as my sister ; two years ago I was four times as old ; last year I was three times as old ; and this year I am two and one-half times as old."

What are their ages ?

46.—A SQUARE FAMILY

A MAN had nine children, all born at regular intervals, and the sum of the squares of their ages was equal to square of his own. What was the age of each ? Every age was an exact number of years.

47.—THE QUARRELSOME CHILDREN

A MAN married a widow, and they each already had children. Ten years later there was a pitched battle engaging the present family of twelve children. The mother ran to the father and cried, "Come at once ! Your children and my children are fighting our children ! " As the parents now had each nine children of their own, how many were born during the ten

48.—ROBINSON'S AGE

"How old are you, Robinson ? " asked Colonel Crackham one morning.

"Well, I forget exactly," was the reply ; "but my brother is two years older than I, my sister is four years older than he, my mother was twenty

when I was born, and I was told yesterday that the average age of the four of us is thirty-nine years."

What was Robinson's age?

49.—THE ENGINE-DRIVER'S NAME

THREE business men—Smith, Robinson, and Jones—all live in the Leeds-Sheffield district. Three railwaymen of similar names live in the same district. The business man Robinson and the guard live at Sheffield, the business man Jones and the stoker live at Leeds, while the business man Smith and the engine-driver live half-way between Leeds and Sheffield. The guard's namesake earns £1,000, 10s. 2d. per annum, and the engine-driver earns exactly one-third of the business man living nearest to him. Finally, the railwayman Smith beats the stoker at billiards.

What is the engine-driver's name?

50.—BUYING RIBBON

HERE is a puzzle that appears to bear a strong family resemblance to others given in the past. But it really requires an entirely different method of working. The author is unknown.

Four mothers, each with one daughter, went into a shop to buy ribbon. Each mother bought twice as many yards as her daughter, and each person bought as many yards of ribbon as the number of farthings she paid for each yard. Mrs. Jones spent 1s. 7d. more than Mrs. White; Nora bought three yards less than Mrs. Brown; Gladys bought two yards more than Hilda, who spent 1s.

less than Mrs. Smith. What is the name of Mary's mother?

51.—SHARING THE APPLES

WHILE the Crackhams were taking in petrol a little outside a pleasant village, eight children on their way to school stopped to look at them. They had a basket containing thirty-two apples, which they were taking into the village to sell. Aunt Gertrude, in a generous mood, bought the lot, and said the children might divide them amongst themselves. Dora asked the names of all the children, and said, later in the day (though she was drawing a little on her imagination), "Anne got one apple, Mary two, Jane three, and Kate four. But Ned Smith took as many as his sister, Tom Brown twice as many as his sister, Bill Jones three times as many as his sister, and Jack Robinson four times as many as his sister. Now which of you can give me the full names of the girls?"

52.—IN THE YEAR 1900

A CORRESPONDENT proposes the following question. The reader may think, at first sight, that there is insufficient data for an answer, but he will be wrong:

A man's age at death was one-twenty-ninth of the year of his birth. How old was he in the year 1900?

53.—FINDING A BIRTHDAY

A CORRESPONDENT informs us incidentally that on Armistice Day (Nov. 11,

1928) he would have lived as long in the twentieth century as he lived in the nineteenth. This tempted us to work out the day of his birth. Perhaps the reader may like to do the same. We will assume he was born at midday.

54.—THE BIRTH OF BOADICEA

A CORRESPONDENT (R. D.) proposes the following little puzzle :

Boadicea died one hundred and twenty-nine years after Cleopatra was born. Their united ages (that is, the combined years of their complete lives) were one hundred years. Cleopatra died 30 B.C. When was Boadicea born ?

55.—ELIZA'S SURNAME

READERS will remember the old puzzle of the "Dutchmen's Wives," nearly two hundred years old. Here is a new extension of it (sent by C. C. P. S.) :

Smith, Brown, and Robinson have provided themselves with a penny pencil each, and took their wives to a stock-broker's office to buy shares. Mary bought 50 more shares than Brown, and Robinson 120 more than Jane. Each man paid as many shillings per share as he bought shares, and each wife as many pence per share as she bought shares, and every man spent one guinea more than his wife. What was Eliza's surname ?

CLOCK PUZZLES

56.—THE AMBIGUOUS CLOCK

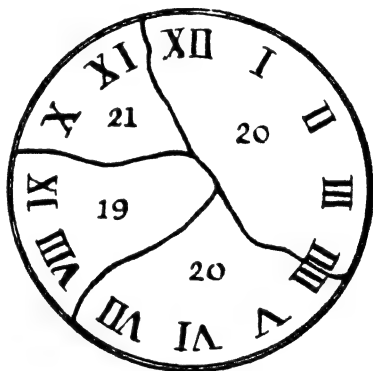
A MAN had a clock with an hour hand and minute hand of the same length

(8,046)

and indistinguishable. If it was set going at noon, what would be the first time that it would be impossible, by reason of the similarity of the hands, to be sure of the correct time ?

Readers will remember that with these clock puzzles there is the convention that we may assume it possible to indicate fractions of seconds. On this assumption an exact answer can be given.

57.—THE BROKEN CLOCK



COLONEL CRACKHAM asked his family at the breakfast-table if, without having a dial before them, they could correctly draw in Roman letters the hours round a clock face. George fell into the trap that catches so many people, of writing the fourth hour as IV. instead of IIII.

Colonel Crackham then asked them to show how a dial may be broken into four parts so that the numerals on each part shall in every case sum to 20. As an example he gave our illustration, where it will be found that the separated numerals on two parts sum to 20,

but on the other parts they add up to 19 and 21 respectively, so it fails.

58.—WHEN DID THE DANCING BEGIN ?

"THE guests at that ball the other night," said Dora at the breakfast-table, "thought that the clock had stopped, because the hands appeared in exactly the same position as when the dancing began. But it was found that they had really only changed places. As you know, the dancing commenced between ten and eleven o'clock. What was the exact time of the start ?"

59.—MISTAKING THE HANDS

"BETWEEN two and three o'clock yesterday," said Colonel Crackham, "I looked at the clock and mistook the minute hand for the hour hand, and consequently the time appeared to be fifty-five minutes earlier than it actually was. What was the correct time ?"

60.—EQUAL DISTANCES

A FEW mornings ago the following clock puzzle was sprung on his pupils by Professor Rackbrane. At what time between three and four o'clock is the minute hand the same distance from VIII as the hour hand is from XII ?

61.—RIGHT AND LEFT

At what time between three and four o'clock will the minute hand be as far from twelve on the left side of the dial

plate as the hour hand is from twelve on the right side of the dial plate ?

62.—AT RIGHT ANGLES

RACKBRANE asked his young friends at the breakfast-table one morning this little question :

"How soon between the hours of five and six will the hour and minute hands of a clock be exactly at right angles ?"

63.—WESTMINSTER CLOCK

A MAN crossed over Westminster Bridge one morning between eight and nine o'clock by the tower clock (often mistakenly called Big Ben, which is name of the large bell only. But this by the way). On his return between four and five o'clock he noticed that the hands were exactly reversed. What were the exact times that he made the two crossings ?

LOCOMOTION AND SPEED PUZZLES

64.—THE BATH CHAIR

A CORRESPONDENT informs us that a friend's house at A, where he was invited to lunch at 1 p.m., is a mile from his own house at B. He is an invalid, and at 12 noon started in his Bath from B towards C. His friend, who had arranged to join him and help push back, left A at 12.15 p.m., walking

at five miles per hour towards C. He joined him, and with his help they went back at four miles per hour, and arrived at A at exactly 1 p.m. How far did our correspondent go towards C?

65.—THE PEDESTRIAN PASSENGER

A TRAIN is travelling at the rate of sixty miles per hour. A passenger at the back of the train wishes to walk to the front along the corridor, and in doing so walks at the rate of three miles per hour. At what rate is the man travelling over the permanent way? We will not involve ourselves here in quibbles and difficulties, similar to Zeno's paradox of the arrow, and Einstein's theory of relativity, but deal with the matter in the simple sense of motion in reference to the permanent way.

66.—MEETING TRAINS

At Wurzelton Junction an old lady put her head out of the window and shouted :

"Guard! how long will the journey be from here to Mudville?"

"All the trains take five hours, ma'am, either way," replied the official.

"And how many trains shall I meet on the way?"

This absurd question tickled the guard, but he was ready with his reply :

"A train leaves Wurzelton for Mudville, and also one from Mudville to Wurzelton, at five minutes past every hour. Right away!"

The old lady induced one of her fellow-

passengers to work out the answer for her. What is the correct number of trains?

67.—CARRYING BAGS

A GENTLEMAN had to walk to his railway station, four miles from his house, and was encumbered by two bags of equal weight, but too heavy for him to carry alone. His gardener and the boy both insisted on carrying the luggage; but the gardener is an old man, and the boy not sufficiently strong, while the gentleman believes in a fair division of labour, and wished to take his own share. They started off with the gardener carrying one bag and the boy the other, while the gentleman worked out the best way of arranging that the three should share the burden equally among them. Now, how would you have managed it?

68.—THE MOVING STAIRCASE

"I COUNTED fifty steps that I made in going down the moving staircase," said Walker.

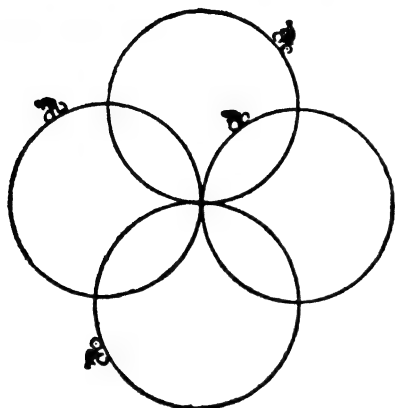
"I counted seventy-five steps," said Trotman; "but I was walking down three times as quickly as you."

If the staircase were stopped, how many steps would be visible? It is assumed that each man travelled at a uniform rate, and the speed of the staircase was also constant?

69.—THE FOUR CYCLISTS

THE four circles represent cinder paths. The four cyclists started at noon. Each

person rode round a different circle, one at the rate of six miles an hour, another



at the rate of nine miles an hour, another at the rate of twelve miles an hour, and the fourth at the rate of fifteen miles an hour. They agreed to ride until all met at the centre, from which they started, for the fourth time. The distance round each circle was exactly one-third of a mile. When did they finish their ride?

70.—THE DONKEY-CART

"THREE men," said Crackham, "Atkins, Brown, and Cranby, had to go a journey of forty miles. Atkins could walk one mile an hour, Brown could walk two miles an hour, and Cranby could go in his donkey-cart at eight miles an hour. Cranby drove Atkins a certain distance, and, dropping him to walk the remainder, drove back to meet Brown on the way and carried him to their destination, where they all arrived at the same time. How long did the journey take? Of course each went at a uniform rate throughout."

71.—THE THREE MOTOR-CARS

THREE motor-cars travelling along a road in the same direction are, at a certain moment, in the following positions in relation to one another. Andrews is a certain distance behind Brooks, and Carter is twice that distance in front of Brooks. Each car travels at its own uniform rate of speed, with the result that Andrews passes Brooks in seven minutes, and passes Carter five minutes later. Now, in how many minutes after Andrews would Brooks pass Carter?

72.—THE FLY AND THE MOTOR-CARS

A ROAD is 300 miles long. A motor-car, A, starts at noon from one end and goes throughout at 50 miles an hour, and at the same time another car, B, going uniformly at 100 miles an hour, starts from the other end together with a fly travelling 150 miles an hour. When the fly meets the car A, it immediately turns and flies towards B. (1) When does the fly meet B? The fly then turns towards A and continues flying backwards and forwards between A and B. (2) When will the fly be crushed between the two cars if they collide and it does not get out of the way?

73.—

WE ran up against Percy Longman, a young athlete, the other day when leaving Curley Street tube station. He stopped at the lift, saying, "I always go up by the stairs. A bit of exercise,

you know. But this is the longest stairway on the line—nearly a thousand steps. I will tell you a queer thing about it that only applies to one other smaller stairway on the line. If I go up two steps at a time, there is one step left for the last bound; if I go up three at a time, there are two steps left; if I go up four at a time, there are three steps left; five at a time, four are left; six at a time, five are left; and if I went up seven at a time there would be six risers left over for the last bound. Now, why is that?"

As he went flying up the stairs, three steps at a time, we laughed and said, "He little suspects that if he went up twenty steps at a time there would be nineteen risers for his last bound!" How many risers are there in the Curley Street tube stairway? The platform does not count as a riser, and the top landing does.

74.—THE OMNIBUS RIDE

GEORGE treated his best girl to a ride on a motor omnibus, but on account of his limited resources it was necessary that they should walk back. Now, if the bus goes at the rate of nine miles an hour and they walk at the rate of three miles an hour, how far can they ride so that they may be back in eight hours?

75.—A QUESTION OF TRANS- PORT

TWELVE soldiers had to get to a place twenty miles distant with the quickest

possible dispatch, and had all to arrive at exactly the same time. They requisitioned the services of a man with a small motor-car.

"I can do twenty miles an hour," he said, "but I cannot carry more than four men at a time. At what rate can you walk?"

"All of us can do a steady four miles an hour," they replied.

"Very well," exclaimed the driver, "then I will go ahead with four men, drop them somewhere on the road to walk, then return and pick up four more (who will be somewhere on the road), drop them also, and return for the last four. So all you have to do is to keep walking while you are on your feet, and I will do the rest."

As they started at noon, what was the exact time that they all arrived together?

76.—HOW FAR WAS IT?

"The steamer," remarked one of our officers home from the East, "was able to go twenty miles an hour down-stream, but could only do fifteen miles an hour up-stream. So, of course, she took five hours longer in coming up than in going down."

One could not resist working out mentally the distance from point to point. What was it?

77.—OUT AND HOME

COLONEL CRACKHAM says that his friend, Mr. Wilkinson, walks from his country house into the neighbouring town at the

rate of five miles per hour, and, as he is a little tired, he makes the return journey at the rate of three miles per hour. As the double journey takes him exactly seven hours, can you tell the distance from his house to the town ?

78.—THE MEETING CARS

THE Crackhams made their first stop at Bugleminster, where they were to spend the night at a friend's house. This friend was to leave home at the same time and ride to London to put up at the Crackhams' house. They took the same route, and each car went at its own uniform speed. They kept a look-out for one another, and met forty miles from Bugleminster. George that evening worked out the following little puzzle :

"I find that if, on our respective arrivals, we had each at once proceeded on the return journey at the same speeds we should meet at forty-eight miles from London."

If this were so, what is the distance from London to Bugleminster ?

79.—A CYCLE RACE

Two cyclists race on a circular track. Brown can ride once round the track in six minutes, and Robinson in four minutes. In how many minutes will Robinson overtake Brown ?

80.—A LITTLE TRAIN PUZZLE

A NON-STOP express going sixty miles an hour starts from Bustletown for

Ironchester, and another non-stop express going forty miles an hour starts at the same time from Ironchester for Bustletown. How far apart are they exactly an hour before they meet ? As I have failed to find these cities on any map or in any gazetteer, I cannot state the distance between them, so we will just assume that it is somewhere over 250 miles. If this little puzzle gives the reader much trouble he will certainly smile when he sees the answer.

81.—AN IRISH JAUNT

"It was necessary," said Colonel Crackham, "for me to go one day from Boghooley to Ballyfoyne, where I had to meet a friend. But the only conveyance obtainable was old Pat Doyle's rickety little cart, propelled by a mare whose working days, like her legs, were a bit over."

It was soon evident that our rate of progress was both safe and steady, though unquestionably slow.

"I say, Pat," I inquired after a few minutes' ride, "has your engine got another speed ?"

"Yes, begorra," the driver replied, "but it's not so fast."

"Then we'll keep her on this gear," said I.

Pat assured me that she would keep going at one pace until she got to her journey's end. She wouldn't slow down and she wouldn't put on any spurts.

"We have been on the road twenty minutes," I remarked, looking at my

watch. "How far have we come from Boghooley?"

"Just half as far as it is from here to Pigtown," said Pat.

After a rapid refreshment at Pigtown we went on another five miles, and then I asked Pat how far it was to Ballyfoyne. I got exactly the same reply. It was clear he could only think in terms of Pigtown.

"Just half as far as it is from here to Pigtown."

Another hour's ride and we were at the end of our journey.

What is the distance from Boghooley to Ballyfoyne?

82.—A WALKING PROBLEM

A MAN taking a walk in the country on turning round saw a friend of his walking 400 yards behind in his direction. They each walked 200 yards in a direct line, with their faces towards each other, and you would suppose that they must have met. Yet they found after their 200 yards' walk that they were still 400 yards apart. Can you explain?

DIGITAL PUZZLES

83.—THREE DIFFERENT DIGITS

THE professor, a few mornings ago, proposed that they should find all those numbers composed of three different digits such that each is divisible without remainder by the square of the sum of those digits. Thus, in the case of 112,

the digits sum to 4, the square of which is 16, and 112 can be divided by 16 without remainder, but unfortunately 112 does not contain three *different* digits. Can the reader find all the possible answers?

84.—FIND THE CUBE

RACKBRANE says that a number increased by its cube is 592,788. He wants to know what that number is.

85.—SQUARES AND TRIANGULARS

WHAT is the third lowest number that is both a triangular and a square? Of course the numbers 1 and 36 are the two lowest that fulfil the conditions. What is the next number?

86.—DIGITS AND CUBES

PROFESSOR RACKBRANE recently asked —3 young friends to find all those figure squares such that the formed by the first two figures added to that formed by the last two figures should equal a cube. Thus with the square of 141, which is 19,881, if we add 19 and 81 together we get 100, which is a square but unfortunately not a cube. How many solutions are there altogether?

87.—REVERSING THE DIGITS

WHAT number composed of nine figures, if multiplied by 1, 2, 3, 4, 5, 6, 7, 8, 9, will give a product with 9, 8, 7, 6, 5, 4, 3, 2, 1 (in that order), in the last nine places to the right?

88.—DIGITAL PROGRESSION

"If you arrange the nine digits," said Professor Rackbrane, "in three numbers thus, 147, 258, 369, they have a common difference of 111, and are, therefore, in arithmetical progression."

Can you find four ways of re-arranging the nine digits so that in each case the number shall have a common difference and the middle number be in every case the same?

89.—FORMING WHOLE NUMBERS

CAN the reader give the sum of all the whole numbers that can be formed with the four figures 1, 2, 3, 4? That is, the addition of all such numbers as 1,234, 1,423, 4,312, etc. You can, of course, write them all out and make the addition, but the interest lies in finding a very simple rule for the sum of all the numbers that can be made with four different digits selected in every possible way, but nought excluded.

90.—SUMMING THE DIGITS

PROFESSOR RACKBRANE wants to know what is the sum of all the numbers that can be formed with the complete nine digits (0 excluded), using each digit once, and once only, in every number?

91.—SQUARING THE DIGITS

TAKE nine counters numbered 1 to 9, and place them in a row as shown. It is required in as few exchanges of pairs

as possible to convert this into a square number. As an example in six pairs we give the following: 7 8 (exchanging 7 and 8), 8 4, 4 6, 6 9, 9 3, 3 2, which gives us the number 139,854,276, which is the square of 11,826. But it can be done in much fewer moves.

92.—DIGITS AND SQUARES

ONE of Rackbrane's little Christmas puzzles was this: (1) What is the smallest square number, and (2) what is the largest square number that contains all the ten digits (1 to 9 and 0) once, and once only?

93.—FIGURES FOR LETTERS

PROFESSOR RACKBRANE the other morning gave his young friends this rather difficult problem. He wrote down the letters of the alphabet in this order:

ABCDXEF GHI = ACGEFHIBD

Every letter, he said, stood for a different digit, 1 to 9 (0 excluded). The number represented by the first four digits, when multiplied by the number containing five digits, equals the number containing all the nine digits in the order shown. Can you substitute digits for letters so that it works?

94.—SIMPLE MULTIPLICATION

HERE is a little puzzle that George Crackham produced at the breakfast-table one morning:

He asked them to substitute for the stars all the ten digits in each row, so arranged as to form a correct little sum in multiplication. He said that the o was not to appear at the beginning or end of either number. Can the reader find an answer ?

95.—BEESWAX

THE word BEESWAX represents a number in a criminal's secret code, but the police had no clue until they discovered among his papers the following sum :

E	A	S	E	B	S	B	S	X
B	P	W	W	K	S	E	T	Q
<hr/>								
K	P	E	P	W	E	K	K	Q

The detectives assumed that it was an addition sum, and utterly failed to solve it. Then one man hit on the brilliant idea that perhaps it was a case of subtraction. This proved to be correct, and by substituting a different figure for each letter, so that it worked out correctly, they obtained the secret code. What number does BEESWAX represent ?

96.—WRONG TO RIGHT

"Two wrongs don't make a right," said somebody at the breakfast-table.

I am not so sure about that," Colonel Crackham remarked. "Take this as an example. Each letter represents a different digit, and no o is allowed."

W	R	O	N	G
W	R	O	N	G
<hr/>				
R	I	G	H	T

If you substitute correct figures the
(3,646)

little addition sum will work correctly. There are several ways of doing it."

97.—LETTER MULTIPLICATION

IN this little multiplication sum the five letters represent five different digits.

What

is no o.

S	E	A	M	
<hr/>				
T				
<hr/>				
M	E	A	T	S

98.—DIGITAL MONEY

EVERY letter in the following multiplication represents one of the digits, 1, 2, 3, 4, 5, 6, 7, 8, 9, all different. What is the value obtained if $K = 8$?

A	B	C		
		K		
<hr/>				
D	E	F	G	H

99.—THE CONSPIRATORS' CODE

A CORRESPONDENT (G. P.) sends this interesting puzzle. Two had a secret code. Their letters sometimes contained little arithmetical sums relating to some quite plausible discussion, and having an entirely innocent appearance. But in their code each of the ten digits represented a different letter of the alphabet. Thus, on one occasion, there was a little sum in simple addition which, when the letters were substituted for the figures, read as follows

F	L	Y	
F	O	R	
<hr/>			
Y	O	U	R
<hr/>			
L	I	F	E

It will be found an interesting puzzle to reconstruct the addition sum with the help of the clue that I and O stand for the figures 1 and 0 respectively.

100.—DIGITAL SQUARES

It will be found a very good puzzle to try to discover a number which, together with its square, shall contain all the nine digits once, and once only, the nought disallowed. Thus, if the square of 378 happened to be 152,694, it would be a perfect solution. But unfortunately the actual square is 142,884, which gives us those two repeated 4's and 8's, and omits the 6, 5, and 9. There are only two possible cases, and these may be discovered in about a quarter of an hour if you proceed in the right way.

101.—FINDING A SQUARE

HERE are six numbers: 4,784,887, 2,494,651, 8,595,087, 1,385,287, 9,042,451, 9,406,087. It is known that three of these numbers added together will form a square. Which are they? The reader will probably see no other course but rather laborious trial, and yet the answer may be found directly by very simple arithmetic and without any experimental extraction of a square root.

102.—JUGGLING WITH DIGITS

ARRANGE the ten digits in three arithmetical sums, employing three of the four operations of addition, subtraction, multiplication, and division, and using no signs except the ordinary ones im-

plying those operations. Here is an example to make it quite clear:

$$3 + 4 = 7; 9 - 8 = 1; 30 \div 6 = 5.$$

But this is not correct, because 2 is omitted, and 3 is repeated.

103.—EXPRESSING TWENTY-FOUR

In a book published in America was the following:

"Write 24 with three equal digits, none of which is 8. (There are two solutions to this problem.)"

Of course the answers given are $22 + 2 = 24$, and $3^3 - 3 = 24$. Readers who are familiar with the old "Four Fours" puzzle, and others of the same class, will ask why there are supposed to be only these solutions. With which of the remaining digits is a solution equally possible?

104.—LETTER-FIGURE

A CORRESPONDENT (C. E. B.) sends the following. It is not difficult, if properly attacked:

$A \times B = B$, $B \times C = AC$, $C \times D = B C$, $D \times E = C H$, $E \times F = D K$, $F \times H = C J$, $H \times J = K J$, $J \times K = E$, $K \times L = L$, $A \times L = L$. Every letter represents a different digit, and, of course, A C, B C, etc., are two-figure numbers. Can you find the values in figures of all the letters?

105.—EQUAL FRACTIONS

CAN you construct three ordinary vulgar fractions (say, $\frac{1}{2}$, $\frac{1}{3}$, or $\frac{1}{4}$, or anything up

to $\frac{1}{2}$ inclusive) all of the same value, using in every group all the nine digits once, and once only? The fractions may be formed in one of the following ways:

$$\frac{a}{b} = \frac{c}{d} = \frac{ef}{ghj}, \text{ or } \frac{a}{b} = \frac{c}{de} = \frac{fg}{hj}.$$

We have only found five cases, but the fifth contains a simple little trick that may escape the reader.

106.—DIGITS AND PRIMES

Using the nine digits once, and once only, can you find prime numbers (numbers that cannot be divided, without remainder, by any number except 1 and itself) that will add up to the smallest total possible? Here is an example. The four prime numbers contain all the nine digits once, and once only, and add up to 450, but this total can be considerably reduced. It is quite an easy puzzle..

$$\begin{array}{r} 61 \\ 283 \\ 47 \\ \hline 59 \\ \hline 450 \end{array}$$

107.—A SQUARE OF DIGITS

2	1	8	2	7	3	3	2	7
4	3	9	5	4	6	6	5	4
6	5	7	8	1	9	9	8	1

THE nine digits may be arranged in a square in many ways, so that the numbers formed in the first row and second row will sum to the third row. We give three examples, and it will be found that

the difference between the first total, 657, and the second, 819, is the same as the difference between the second, 819, and the third, 981—that is, 162. Now, can you form eight such squares, every one containing the nine digits, so that the common difference between the eight totals is throughout the same? Of course it will not be 162.

108.—THE NINE DIGITS

It will be found that 32,547,891 multiplied by 6 (thus using all the nine digits once, and once only) gives the product 195,287,346 (also containing all the nine digits once, and once only). Can you find another number to be multiplied by 6 under the same conditions? Remember that the nine digits must appear once, and once only, in the sums multiplied and in the product.

109.—PERFECT SQUARES

FIND four numbers such that the sum of every two and the sum of all four may be perfect squares.

110.—AN ABSOLUTE SKELETON

..... is a good skeleton puzzle. only conditions are:

- (1) No digit appears twice in any row of figures except in the dividend.
- (2) If 2 be added to the last figure in the quotient it equals the last but one, and if 2 be added to the third figure from the end it gives the last figure but three in the quotient. That is to say, the quotient might end in, say, 9,742, or in 3,186.


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1	3
2	4
7	5
9	8

VARIOUS ARITHMETICAL AND ALGEBRAICAL PROBLEMS

114.—ELEMENTARY ARITHMETIC

THIS is the kind of question that was very popular in Venice and elsewhere about the middle of the sixteenth century. Nicola Fontana, generally known as "Tartaglia" (the stammerer) was largely responsible for the invention.

If a quarter of twenty is four, what would a third of ten be?

115.—THE EIGHT CARDS

COLONEL CRACKHAM placed eight numbered cards on the breakfast-table, as here shown, and asked his young friends to rearrange them, moving as few as possible, so that the two columns should add up alike. Can it be done?

116.—TRANSFERRING THE FIGURES

If we wish to multiply 571,428 by 5 and divide by 4, we need only transfer the 5 from the beginning to the end for the correct answer, 714,285. Can you find a number that we can multiply by 4 and then divide the product by 5 in the same simple manner, by moving the first figure to the end? Of course 714,285, just given, would do if we were allowed to transfer from the end to the beginning. But it must be from the beginning to the end!

117.—A QUEER ADDITION

COLONEL CRACKHAM asked the junior members of his household at the breakfast-table to write down five odd figures so that they will add up and make fourteen. Only one of them did it.

118.—SIX SIMPLE QUESTIONS

(1) DEDUCT four thousand eleven hundred and a half from twelve thousand twelve hundred and twelve. (2) Add 3 to 182, and make the total less than 20. (3) What two numbers multiplied together will produce seven? (4) What three figures multiplied by five will make six? (5) If five times four are 33, what is the fourth of 20? (6) Find a fraction whose numerator is less than its denominator, but which, reversed, shall remain of the same value.

119.—THE THREE DROVERS

As the Crackhams were approaching a certain large town they met and were delayed in passing first a flock of sheep, then a drove of oxen, and afterwards some men leading a number of horses. They ascertained that it was a special market-day at the town. George seized the occasion to construct the following puzzle:

‘Three drovers with varied flocks met on the highway,’ he proposed. ‘Said Jack to Jim: ‘If I give you six pigs for a horse then you will have twice as many animals in your drove as I will have in mine.’ Said Dan to Jack: ‘If I give you fourteen sheep for a horse, then you’ll have three times as many animals as I have got.’ Said Jim to Dan: ‘But if I give you four cows for a horse, then you’ll have six times as many animals as I.’ There were no deals; but can you tell me just how many animals there were in the three droves?’

120.—PROPORTIONAL REPRESENTATION

WHEN stopping at Mangleton-on-the-Bliss the Crackhams found the inhabitants of the town excited over some little local election. There were ten names of candidates on a proportional representation ballot paper. Voters should place No. 1 against the candidate of their first choice. They might also place No. 2 against the candidate of their second choice, and so on until all the ten candidates have numbers placed against their names. The voters must mark their first choice, and any others may be marked or not as they wish. George proposed that they should discover in how many different ways the ballot paper might be marked by the voter.

121.—FIND THE NUMBERS

CAN you find two numbers composed only of ones which give the same result by addition and multiplication? Of course 1 and 11 are very near, but they will not quite do, because added they make 12, and multiplied they make only 11.

122.—A QUESTION OF CUBES

PROFESSOR RACKBRANE pointed out one morning that the cubes of successive numbers, starting from 1, would sum to a square number. Thus the cubes of 1, 2, 3 (that is, 1, 8, 27), add to 36, which is the square of 6. He stated that if you are forbidden to use the 1, the lowest answer is the cubes of 23,

24, and 25, which together equal 204^2 . He proposed to seek the next lowest number, using more than three consecutive cubes and as many more as you like, but excluding 1.

123.—TWO CUBES

"CAN you find," Professor Rackbrane asked, "two cube numbers in integers whose difference shall be a square number? Thus the cube of 3 is 27, and the cube of 2 is 8, but the difference, 19, is not here a square number. What is the smallest possible case?"

124.—CUBE DIFFERENCES

IF we wanted to find a way of making the number 1,234,567 the difference between two squares, we could at once write down 617,284 and 617,283—a half of the number plus $\frac{1}{2}$ and minus $\frac{1}{2}$ respectively to be squared. But it will be found a little more difficult to discover two cubes the difference of which is 1,234,567.

125.—ACCOMMODATING SQUARES

CAN you find two three-figure square numbers (no noughts) that, when put together, will form a six-figure square number? Thus, 324 and 900 (the squares of 18 and 30) make 324,900, the square of 570, only there it happens there are two noughts. There is only one answer.

126.—MAKING SQUARES

PROFESSOR RACKBRANE asked his young friends the other morning if they could find three whole numbers in arithmetical progression, the sum of every two of which shall be a square.

127.—FIND THE SQUARES

WHAT number is that," Colonel Crackham asked, "which, added separately to 100 and 164, will make them both perfect square numbers?"

128.—FORMING SQUARES

"AN officer arranged his men in a solid square," said Dora Crackham, "and had thirty-nine men over. He then started increasing the number of men on a side by one, but found that fifty new men would be needed to complete the new square. Can you tell me how many men the officer had?"

129.—SQUARES AND CUBES

FIND two different numbers such that the sum of their squares shall equal a cube, and the sum of their cubes equal a square.

130.—MILK AND CREAM

PROFESSOR RACKBRANE, when helping himself to cream at the breakfast-table, put the following question:

"An honest dairyman found that the milk supplied by his cows was 5 per cent. cream and 95 per cent. skimmed milk.

He wanted to know how much skimmed milk he must add to a quart of whole to reduce the percentage of cream to 4 per cent."

131.—FEEDING THE MONKEYS

A MAN went to the Zoo monkey-house with a bag of nuts. He found that if he divided them equally amongst the eleven monkeys in the first cage he would have one nut over; if he divided them equally amongst the thirteen monkeys in the second cage there would be eight left; if he divided them amongst the seventeen monkeys in the last cage three nuts would remain. He also found that if he divided them equally amongst the forty-one monkeys in all three cages, or amongst the monkeys in any two cages, there would always be some left over. What is the smallest number of nuts that the man could have had in his bag?

132.—SHARING THE APPLES

DORA CRACKHAM the other morning asked her brother this question: "If three boys had a hundred and sixty-nine apples which they shared in the ratio of one-half, one-third, and one-fourth, how many apples did each receive?"

133.—SAWING AND SPLITTING

COLONEL CRACKHAM, one morning at the breakfast-table, said that two men of his acquaintance can saw five cords of wood per day, or they can split eight cords of wood when sawed. He wanted to know

how many cords must they saw in order that they may be occupied for the rest of the day in splitting it.

134.—THE BAG OF NUTS

GEORGE CRACKHAM put five paper bags on the breakfast-table. On being asked what they contained, he said:

"Well, I have put a hundred nuts in these five bags. In the first and second there are altogether fifty-two nuts; in the second and third there are forty-three; in the third and fourth, thirty-four; in the fourth and fifth, thirty."

How many nuts are there in each bag?

135.—DISTRIBUTING NUTS

AUNT MARTHA bought some nuts. She gave Tommy one nut and a quarter of the remainder; Bessie then received one nut and a quarter of what were left; Bob, one nut and a quarter of the re-

one nut and a quarter of the remainder. It was then noticed that the boys had received exactly 100 nuts more than the girls. How many nuts had Aunt Martha retained for her own use?

136.—JUVENILE HIGHWAYMEN

THREE juvenile highwaymen, returning called upon an apple-woman "to stand and deliver." Tom seized half of the apples, but returned ten to the basket; Ben took one-third of what were left, but returned two that he did not fancy; Jim took half of the remainder, but

threw back one that was worm-eaten. The woman was then left with only twelve in her basket. How many apples had she before the raid was made?

137.—BUYING DOG BISCUITS

A SALESMAN packs his dog biscuits (all of one quality) in boxes containing 16, 17, 23, 24, 39, and 40 lbs. respectively, and he will not sell them in any other way, or break into a box. A customer asked to be supplied with 100 lbs. of the biscuits. Could you have carried out the order? If not, how near could you have got to making up the 100 lbs.? Of course, he has an ample supply of boxes of each size.

138.—THE THREE WORKMEN

"ME and Bill," said Casey, "can do the job for you in ten days, but give me Alec instead of Bill, and we can get it done in nine days."

"I can do better than that," said Alec. "Let me take Bill as a partner, and we will do the job for you in eight days."

Then how long would each man take over the job alone?

139.—WORKING ALONE

ALFRED and Bill together can do a piece of work in twenty-four days. If Alfred can do only two-thirds as much as Bill, how long will it take each of them to do the work alone?

(3,646)

140.—A CURIOUS PROGRESSION

A CORRESPONDENT sent this:

"An arithmetical progression is 10, 20, 30, 40, 50, the five terms of which sum is 150. Find another progression of five terms, without fractions, which sum to 153." We noted at once the wily omission of a word in the last sentence, because such an arithmetical progression is not possible. We therefore suggested, by way of jest, this queer solution: a progression of five current silver coins, 3d., 1s., 2s. 6d., 4s., 5s., which sum to 153 pence. But this is not his own answer, which is quite satisfying—no algebraical complexities. What is it?

141.—THE FIRST "BOOMERANG" PUZZLE

ONE of the most ancient forms of arithmetical puzzle is that which I call the "Boomerang." Everybody has been asked at some time or another to "Think of a number," and, after going through some process of private calculation, to state the result, when the questioner promptly tells you the number you thought of. There are hundreds of varieties of the puzzle. The oldest recorded example appears to be that given in the *Arithmetica* of Nicomachus, who died about the year 120. He tells you to think of any whole number between 1 and 100, and then divide it successively by 3, 5, and 7, telling him the remainder in each case. On receiving this information he promptly discloses the number you thought of.

Can the reader discover a simple method of mentally performing this feat? If not, he will perhaps be interested in seeing how the ancient mathematician did it.

142.—LONGFELLOW'S BEES

WHEN Longfellow was Professor of Modern Languages at Harvard College he was accustomed to amuse himself by giving more or less simple arithmetical puzzles to the students. Here is an example: If one-fifth of a hive of bees flew to the ladamba flower, one-third flew to the slandbara, three times the difference of these two numbers flew to an arbour, and one bee continued to fly about, attracted on each side by the fragrant ketaki and the malati, what was the number of bees?

143.—"LILIVATI," A.D. 1150

HERE is another little morning problem from *Lilivati* (A.D. 1150).

Beautiful maiden, with beaming eyes, tell me which is the number that, multiplied by 3, then increased by three-fourths of the product, divided by 7, diminished by one-third of the quotient, multiplied by itself, diminished by 52, the square root found, addition of 8, division by 10, gives the number 2?

This, like so many of those old things, is absurdly easy if properly attacked.

144.—BIBLICAL ARITHMETIC

IF you multiply the number of Jacob's sons by the number of times which the

Israelites compassed Jericho on the seventh day, and add to the product the number of measures of barley which Boaz gave Ruth, divide this by the number of Haman's sons, subtract the number of each kind of clean beasts that went into the Ark, multiply by the number of men that went to seek Elijah after he was taken to Heaven, subtract from this Joseph's age at the time he stood before Pharaoh, add the number of stones in David's bag when he killed Goliath, subtract the number of furlongs that Bethany was distant from Jerusalem, divide by the number of anchors cast out when Paul was shipwrecked, subtract the number of persons saved in the Ark, and the answer will be the number of pupils in a certain Sunday school class. How many pupils are in the class?

145.—THE PRINTER'S PROBLEM

A PRINTER had an order for 10,000 bill forms per month, but each month the name of the particular month had to be altered: that is, he printed 10,000 "JANUARY," 10,000 "FEBRUARY," 10,000 "MARCH," etc.; but as the particular types with which these words were to be printed had to be specially obtained, and were expensive, he only purchased just enough movable types to enable him, by interchanging them, to print in turn the whole of the months of the year. How many separate types did he purchase? Of course, the words were printed throughout in capital letters, as shown.

146.—THE SWARM OF BEES

HERE is an example of the elegant way in which Bhaskara, in his great work, *Lilivati*, in 1150, dressed his little puzzles :

The square root of half the number of bees in a swarm has flown out upon a jessamine bush; eight-ninths of the whole swarm has remained behind; one female bee flies about a male that is buzzing within the lotus flower into which he was allured in the night by its sweet odour, but is now imprisoned in it. Tell me the number of bees.

147.—BLINDNESS IN BATS

A NATURALIST, who was trying to pull the leg of Colonel Crackham, said that he had been investigating the question of blindness in bats. "I find," he said, "that their long habit of sleeping in dark corners during the day, and only going abroad at night, has really led to a great prevalence of blindness among them, though some had perfect sight and others could see out of one eye. Two of my bats could see out of the right eye, just three of them could see out of the left eye, four could not see out of the left eye, and five could not see out of the right eye."

He wanted to know the smallest number of bats that he must have examined in order to get these results.

148.—A MENAGERIE

A TRAVELLING menagerie contained two freaks of nature—a four-footed bird and a six-legged calf. An attendant was

asked how many birds and beasts there were in the show, and he said :

"Well, there are 36 heads and 100 feet altogether. You can work it out for yourself."

How many were there ?

149.—SHEEP STEALING

SOME sheep stealers made a raid and carried off one-third of the flock of sheep, and one-third of a sheep. other party stole one-fourth of what remained, and one-fourth of a sheep. Then a third party of raiders carried off one-fifth of the remainder and three-fifths of a sheep, leaving 409 behind. What was the number of sheep in the flock ?

150.—SHEEP SHARING

A CORRESPONDENT (C. H. P.) puts the following little question :

An Australian farmer dies and leaves his sheep to his three sons. Alfred is to get 20 per cent. more than John, and 25 per cent. more than Charles. John's share is 3,600 sheep. How many sheep does Charles get ? Perhaps readers may like to give this a few moments' consideration.

151.—THE ARITHMETICAL CABBY

THE driver of the taxi-cab was wanting in civility, so Mr. Wilkins asked him for his number.

"You want my number, do you ?" said the driver. "Well, work it out for yourself. If you divide my number by

2, 3, 4, 5, or 6 you will find there is always 1 over; but if you divide it by 11 there ain't no remainder. What's more, there is no other driver with a lower number who can say the same."

What was the fellow's number?

152.—THE LENGTH OF A LEASE

"I HAPPENED to be discussing the tenancy of a friend's property," said the Colonel, "when he informed me that there was a 99 years' lease. I asked him how much of this had already expired, and expected a direct answer. But his reply was that two-thirds of the time past was equal to four-fifths of the time to come, so I had to work it out for myself."

153.—A MILITARY PUZZLE

AN officer wished to form his men into twelve rows, with eleven men in every row, so that he could place himself at a point that would be equidistant from every row.

"But there are only one hundred and twenty of us, sir," said one of the men.

Was it possible to carry out the order?

154.—MARCHING AN ARMY

A BODY of soldiers was marching in regular column, with five men more in depth than in front. When the enemy came in sight the front was increased by 845 men, and the whole was thus drawn up in five lines. How many men were there in all?

155.—THE ORCHARD PROBLEM

A MARKET gardener was planting a new orchard. The young trees were arranged in rows so as to form a square, and it was found that there were 146 trees unplanted. To enlarge the square by an extra row each way he had to buy 31 additional trees.

How many trees were there in the orchard when it was finished?

156.—MULTIPLYING THE NINE DIGITS

THEY were discussing mental problems at the Crackhams' breakfast-table, when George suddenly asked his sister Dora to multiply as quickly as possible

$$1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8 \times 9 \times 0.$$

How long would it have taken the reader?

157.—COUNTING THE MATCHES

A FRIEND writes to say he bought a little box of midget matches, each one inch in length. He found that he could arrange them all in the form of a triangle whose area was just as many square inches as there were matches. He then used up six of the matches, and found that with the remainder he could again construct another triangle whose area was just as many square inches as there were matches. And using another six matches he could again do precisely the same. How many matches were there in the box originally? The number is less than forty.

158.—NEWSBOYS

AN interesting little contest took place amongst some newspaper boys. Tom Smith sold one paper more than a quarter of the whole lot they had secured; Billy Jones disposed of one paper more than a quarter of the remainder; Ned Smith sold one paper more than a quarter of what was left; and Charlie Jones disposed of just one paper more than a quarter of the remainder. At this stage it was found that the Smiths were exactly one hundred papers ahead, but little Jimmy Jones, the youngest kid of the bunch, sold all that were left; so that in this friendly encounter the Joneses won by how many papers do you think?

159.—THE YEAR 1927

A FRENCH correspondent sends the following little curiosity. Can you find values for p and q so that $p^2 - q^2 = 1927$? To make it perfectly clear, we will give an example for the year 1844, where $p = 3$, and $q = 7$:

$$3^2 - 7^2 = 1844.$$

Can you express 1927 in the same curious way?

160.—BOXES OF CORDITE

CORDITE charges (writes W. H.-J.) for 6-inch howitzers were served out from ammunition dumps in boxes of 15, 18, and 20.

"Why the three different sizes of boxes?" I asked the officer on the dump. He answered—

"So that we can give any battery the number of charges it needs without breaking a box."

This was an excellent system for the delivery of a large number of boxes, but failed in small cases, like 5, 10, 25, and 61. Now, what is the biggest number of charges that cannot be served out in whole boxes of 15, 18, and 20? It is not a very large number.

161.—BLOCKS AND SQUARES

HERE is a curious but not easy puzzle that appeared, we believe, some ten years ago, though the author is not traced.

Three children each possess a box containing similar cubic blocks, the



same number of blocks in every box. The first girl was able, using all her blocks, to make a hollow square, as indicated by A. The second girl made a larger square, as B. The third girl made a still larger square, as C, but had four blocks left over for the corners, as shown. Each girl used all her blocks at each stage. What is the smallest number of blocks that each box could have contained?

The diagram must not be taken to truly represent the proportion of the various squares.

162.—FIND THE TRIANGLE

THE sides and height of a triangle are four consecutive whole numbers. What is the area of the triangle?

163.—DOMINO FRACTIONS

HERE is a new puzzle with dominoes. Taking an ordinary box, discard all doubles and blanks. Then, substituting figures for the pips, regard the remaining fifteen dominoes as fractions. It will be seen in the illustration that I have so

$$\boxed{\frac{3}{4}} + \boxed{\frac{1}{4}} + \boxed{\frac{3}{6}} + \boxed{\frac{1}{2}} + \boxed{\frac{2}{4}} = 2\frac{1}{2}$$

$$\boxed{\frac{5}{6}} + \boxed{\frac{2}{6}} + \boxed{\frac{1}{3}} + \boxed{\frac{4}{5}} + \boxed{\frac{1}{5}} = 2\frac{1}{2}$$

3

arranged them that the fractions in every row of five dominoes sum to exactly $2\frac{1}{2}$. But I have only used proper fractions. You are allowed to use as many improper fractions (such as $\frac{3}{2}$, $\frac{5}{3}$, $\frac{4}{2}$) as you like, but must make the five dominoes in every rank sum to 10.

164.—COW, GOAT, AND GOOSE

A FARMER found that his cow and goat would eat all the grass in a certain field in 45 days, that the cow and the goose would eat it in 60 days, but that it

would take the goat and the goose 90 days to eat it down. Now, if he had turned cow, goat, and goose into the field together, how long would it have taken them to eat all the grass? Sir Isaac Newton showed us how to solve a puzzle of this kind with the grass growing all the time; but, for the sake of greater simplicity, we will assume that the season and conditions were such that the grass was not growing.

165.—THE POSTAGE-STAMPS
PUZZLE

A YOUTH who collects postage stamps was asked how many he had in his album, and he replied:

"The number, if divided by 2, will give a remainder 1; divided by 3, a remainder 2; divided by 4, a remainder 3; divided by 5, a remainder 4; divided by 6, a remainder 5; divided by 7, a remainder 6; divided by 8, a remainder 7; divided by 9, a remainder 8; divided by 10, a remainder 9. But there are fewer than 3,000."

Can you tell how many stamps there were in the album?

166.—HENS AND TENS

IF ten hen-pens cost ten and tenpence, and ten hens and one hen-pen cost ten and tenpence, what will ten hens without any hen-pens cost?

167.—THE CANCELLED CHEQUE

HERE is a facsimile of a cheque. These bankers always cancel their paid cheques

by punching star-shaped holes in them.
It will be seen that in this case they have

No. ★★★★★★ 1st April, 1927.
Messrs. Dunderhead & Co.,
10 Lombard Street, E.C. 3.
£50.00

happened to punch out the six figures that form the number of the cheque. The puzzle is to find out what those figures were. It was a square number multiplied by 113, and when divided into three two-figure numbers by the lines crossing the cheque (as shown), each of these three numbers was a square number. Can you find the number of the cheque?

168.—MENTAL ARITHMETIC

To test their capacities in mental arithmetic, Rackbrane asked his pupils the other morning to do this:

Find two whole numbers (each less than 10) such that the sum of their squares, added to their product, will make a square.

The answer was soon found.

169.—SHOOTING BLACKBIRDS

TWICE four and twenty blackbirds
Were sitting in the rain;
I shot and killed a seventh part,
How many did remain?

170.—THE SIX NOUGHTS

B	C
111	100
333	000
500	005
077	007
090	999
<u>1,111</u>	<u>1,111</u>

Write down the little addition sum A, which adds up 2,775. Now substitute six noughts for six of the figures, so that the total sum shall be 1,111. It will be seen that in the case B five noughts have been substituted, and in case C nine noughts. But the puzzle is to do it with six noughts.

171.—MULTIPLICATION DATES

In the year 1928 there were four dates which, written in a well-known manner, the day multiplied by the month will equal the year. These are 28/1/28, 14/2/28, 7/4/28, and 4/7/28. How many times in this century—1901–2000 inclusive—does this so happen? Or, you can try to find out which year in the century gives the largest number of dates that comply with the conditions. There is one year that beats all the others.

172.—CURIOUS MULTIPLICAND

READERS who remember the Ribbon Problem No. 83 in *The Canterbury Puzzles*, may be glad to have this slightly easier variation of it:

What number is it that can be multiplied by 1, 2, 3, 4, 5, or 6 and no new figures appear in the result?

173.—SHORT CUTS

We have from time to time given various short cuts in mental arithmetic. Here is an example that will interest those who are unfamiliar with the process.

Can you multiply 993 by 879 mentally?

It is remarkable that any two numbers of two figures each, where the tens are the same, and the sum of the units digits make 10, can always be multiplied mentally thus: $97 \times 93 = 9,021$. Multiply the 7 by 3 and set it down, then add 1 to the 9 and multiply by the other 9, $9 \times 10 = 90$.

This is very useful for squaring any number ending in 5, as $85^2 = 7,225$. With two fractions, when we have the whole numbers the same and the sum of the fractions equal unity, we get an easy rule for multiplying them. Take $7\frac{1}{8} \times 7\frac{7}{8} = 56\frac{7}{8}$. Multiply the fractions $= \frac{7}{8}$, add 1 to one of the 7's, and multiply by the other, $7 \times 8 = 56$.

174.—MORE CURIOUS MULTIPLICATION

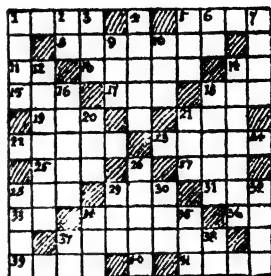
HERE is Professor Rackbrane's latest:

What number is it that, when multiplied by 18, 27, 36, 45, 54, 63, 72, 81, or 99, gives a product in which the first and last figures are the same as those in the multiplier, but which when multiplied by 90 gives a product in which the last two figures are the same as those in the multiplier?

175.—CROSS-FIGURE PUZZLE

HERE is a cross-figure puzzle somewhat on the lines of the familiar "cross-word

puzzle." The puzzle is to put a single figure in every one of the white squares



so that they shall add up correctly as in the table below. Thus, the three figures in the Horizontal A must add up to 9. The two figures in the Vertical A will add up to 4. Then all the Diagonals running downwards from the left (like J, N, R) are called "Down"; those running upwards from the left (like X, U, Q, M, J) are called "Up." In making your addition you stop at the blacked-out squares, as in spelling in the case of "cross-word." The puzzle is really very easy if you discover the right way of getting to work, which I will make clear in the solution. The nought does not occur anywhere in the arrangement.

Horizontals.—A, 9 : E, 16 : H, 12 : K, 4 : M, 8 : P, 13 : Q, 32 : S, 5 : V, 8 : W, 3 : X, 9 : Z, 13 : AA, 7 : BB, 9 : DD, 18 : EE, 8.

Verticals.—A, 4 : B, 15 : C, 7 : D, 34 : E, 4 : F, 16 : G, 8 : L, 18 : M, 11 : N, 22 : O, 17 : R, 18 : S, 10 : U, 9 : X, 9 : Y, 7.

Diagonals (Down).—B, 15 : F, 11 : H, 26 : J, 19 : K, 11 : L, 26.

Diagonals (Up).—L, 11 : T, 21 : X, 35 : CC, 12 : Z, 20 : EE, 8.

176.—COUNTING THE LOSS

AN officer explained that the force to which he belonged originally consisted of a thousand men, but that it lost heavily in an engagement, and the survivors surrendered and were marched down to a concentration camp.

On the first day's march one-sixth of the survivors escaped ; on the second day one-eighth of the remainder escaped, and one man died ; on the third day's march one-fourth of the remainder escaped. Arrived in camp, the rest were set to work in four equal gangs.

How many men had been killed in the engagement ?

GEOMETRICAL PROBLEMS

GEOMETRICAL PROBLEMS

DISSECTION PUZZLES

177.—SQUARE OF SQUARES

CUTTING only along the lines, what is the smallest number of square pieces into which the diagram can be dissected? The largest number possible is, of course, 169, where all the pieces will be of the same size—one cell—but we want the smallest number. We might cut away the border on two sides, leaving one square 12×12 , and cutting the remainder in 25 little squares, making 26 in all. This is better than 169,

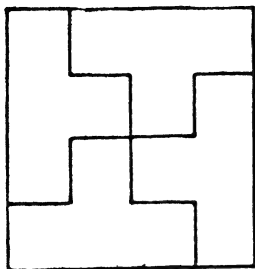
THIS little puzzle calls for a certain amount of ingenuity on account of the awkward position of the cross in the corner.

The puzzle is to cut the square into four parts by going along the lines, so that each part shall be exactly the same size and shape, and each part contain a star and a cross.

179.—GREEK CROSS PUZZLE

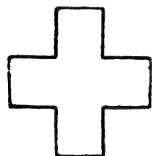
HERE is a little puzzle for our more juvenile readers. Cut square into four pieces in the manner shown, and then put these four pieces together so as to form a symmetrical Greek cross (p. 54).

but considerably more than the fewest possible.



GREEK CROSS PUZZLE

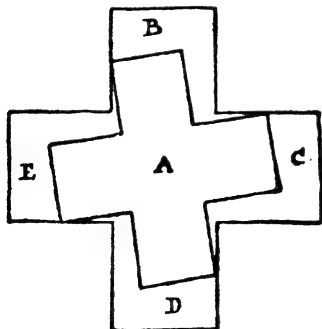
180.—SQUARE AND CROSS



HERE is a Greek cross puzzle. Cut a symmetrical Greek cross into five pieces, so that one piece shall be a smaller symmetrical Greek cross, entire, and so that the remaining four pieces will fit together and form a perfect square.

181.—THREE GREEK CROSSES FROM ONE

IN *Amusements in Mathematics* (page 168) is given this elegant solution for

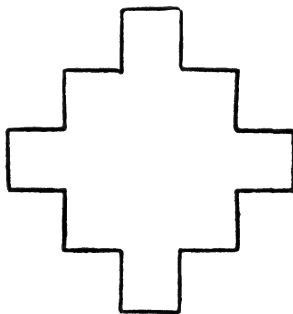


cutting two symmetrical Greek crosses of the same size from a larger cross. Of

course A is cut out entire, and the reader will have no difficulty in placing the other four pieces together to form a similar cross. It was then added: "The difficult question now presents itself—how are we to cut three Greek crosses from one in the fewest possible pieces? As a matter of fact this problem may be solved in as few as thirteen pieces; but as I know many of my readers, advanced geometers, will be glad to have something to work at of which they are not shown the solution, I leave the mystery to the present undisclosed." Only one correspondent has ever succeeded in solving the problem, and his method is exceedingly complex and difficult. Of course the three crosses must be all of one size.

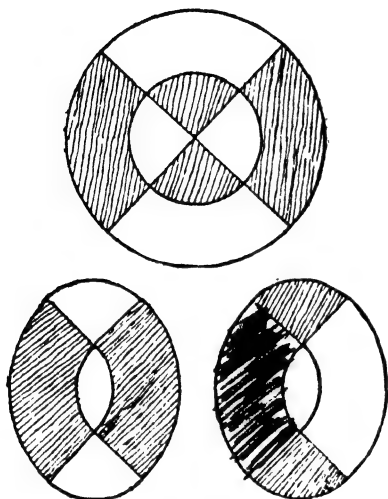
182.—MAKING A SQUARE

HERE is an elegant, but not difficult, little cutting-out puzzle that will in-



terest readers (sent by E. B. E.). Cut the figure into four pieces, each of the same size and shape, that will fit together and form a perfect square.

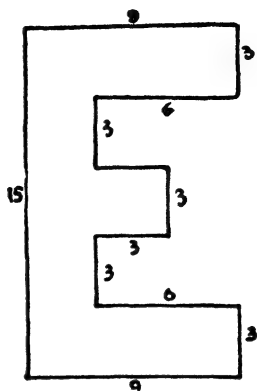
183.—TABLE-TOP AND STOOLS



Most people are familiar with the old puzzle of the circular table-top cut into pieces to form two oval stools, each with a hand-hole. The old solution was in eight pieces, but an improved version was given in only six pieces in *Amusements in Mathematics*, No. 157. Those who remember the puzzle will be interested in a solution in as few as four pieces by the late Sam Loyd. Can you cut the circle into four pieces that will fit together (two and two) and form two oval stool-tops, each with a hand-hole?

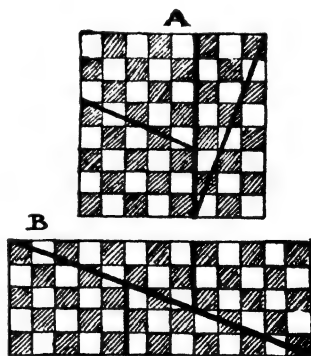
184.—DISSECTING THE LETTER E

In *Modern Puzzles* readers were asked to cut this E into five pieces that would fit together and form a perfect square. It was understood that no piece was to be turned over, but we remarked that it can be done in four pieces if you are allowed to turn over pieces. I



give the puzzle again, with permission to make the reversals. Can you do it in four pieces? We have given all the measurements in inches, so that there shall be no doubt as to the correct proportions of the letter.

185.—THE DISSECTED CHESS-BOARD

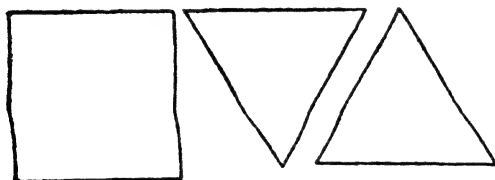


HERE is an ancient and familiar fallacy. If you cut a chessboard into four pieces in the manner indicated by the black lines in Fig. A, and then reassemble the pieces as in Fig. B, you appear to gain a square by the operation, since this second

figure would seem to contain $13 \times 5 = 65$ squares. I have explained this fallacy over and over again, and the reader probably understands all about it. The present puzzle is to place the same four pieces together in another way so that it may appear to the novice that instead of gaining a square we have lost one, the new figure apparently containing only 63 cells. It is best to use the diagram that is not chequered in black and white cells.

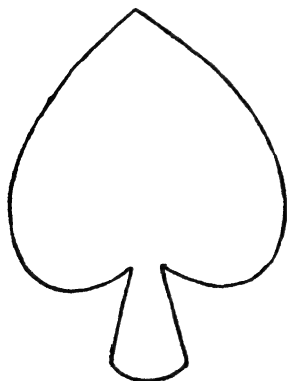
186.—TRIANGLE AND SQUARE

CAN you cut each of the equilateral triangles into three pieces, so that the six



pieces will fit together and form a perfect square?

187.—CHANGING THE SUIT



You are asked to cut the Spade into three pieces that will fit together and form a Heart. Of course no part of the material may be wasted, or it would be absurd, since it would be necessary merely to cut away the stem of the Spade.

188.—SQUARING THE CIRCLE

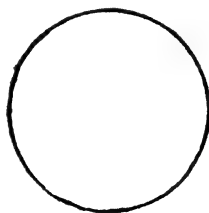
THE problem of squaring the circle depends on finding the ratio of the diameter to the circumference. This

e found in

tude, but we can get it near enough for all practical purposes.

But it is equally impossible, by Euclidean geometry, to draw a straight line equal to the circumference of a given circle. You can roll a penny carefully on its edge along a straight line on a sheet of paper and get a pretty exact result, but such a thing as a circular garden-bed cannot be so rolled.

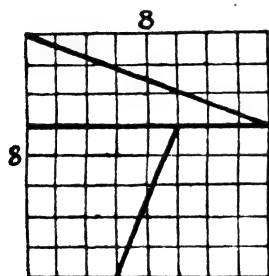
Now, the line below, when straightened out (it is bent for convenience in printing), is very nearly the exact length of the circumference of the accompanying



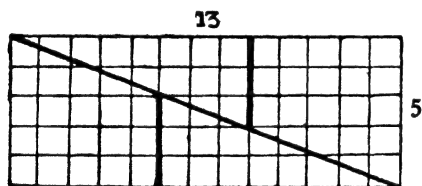
circle. The horizontal part of the line is half the circumference. Could you have found it by a simple method, using only pencil, compasses, and ruler?

189.—PROBLEM OF THE
EXTRA CELL

HERE is a fallacy that is widely known but imperfectly understood. Doubtless many readers will recognize it, and some of them have probably been not a little perplexed. In diagram A the square resembling a chessboard is cut into four pieces along the dark lines, and



A



B

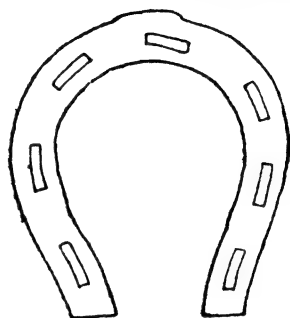
these four pieces are seen re-assembled in diagram B. But in A we have sixty-four of these little square cells, whereas in B we have sixty-five. Where does the additional cell come from?

Examine it carefully and see if you can discover how that extra square creeps in, and whether it is really possible that you can increase the size of a slice of bread and butter by merely cutting it in pieces and putting them together again differently.

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190.—A HORSESHOE PUZZLE

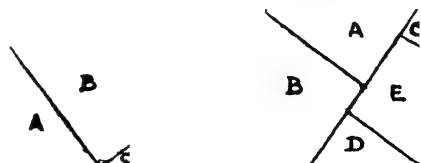
HERE is an easy little puzzle, but have seen people perplexed by it for some time. Given a paper horseshoe,



similar to the one in the illustration, can you cut it into seven pieces, with two straight clips of the scissors, so that each part shall contain a nail hole? There is no objection to your shifting the pieces and putting them together after the first cut, only you must not bend or fold the paper in any way.

191.—TWO SQUARES IN ONE

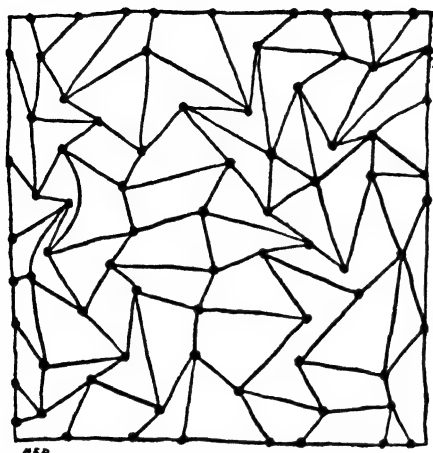
Two squares of any relative size can be cut into five pieces, in the manner shown below, that will fit together and form a larger square. But this involves cut-



ting the smaller square. Can you show an easy method of doing it without in any way cutting the smaller square?

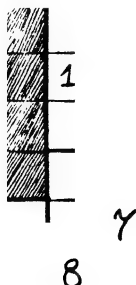
R

192.—THE SUBMARINE NET



THE illustration is supposed to represent a portion of a long submarine net, and the puzzle is to make as few cuts as possible from top to bottom, to divide the net into two parts, and so make an opening for a submarine to pass through. Where would you make the cuts? No cuts can be made through the knots. Only remember the cuts must be made from the top line to the bottom.

193.—SQUARE TABLE-TOP



FROM a square sheet of paper or cardboard, divided into smaller squares, 7×7 , as in the diagram, cut out the eight pieces in the manner indicated. The shaded parts are thrown away. A cabinetmaker had to fit together these eight pieces of veneer to form a small square table-top, 6×6 , and he stupidly cut that piece No. 8 into three parts.

How would you form the square without cutting any one of the pieces?

194.—CUTTING THE VENEER

A CABINETMAKER had a perfect square of beautiful veneer which he wished to cut into six pieces to form three separate squares, all different sizes. How might this have been done without any waste?

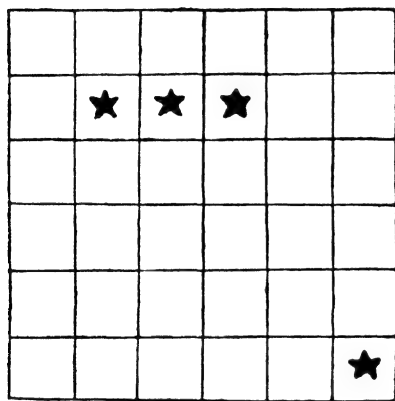
195.—IMPROVISED CHESSBOARD



A GOOD cutting-out puzzle in as few as two pieces is not often forthcoming. Here is one that I think cannot fail to

interest readers. Cut this piece of checkered linoleum into only two pieces, that will fit together and form a perfect chessboard, without disturbing the checkering of black and white. Of course, it would be easy to cut off those two overhanging white squares and put them in the vacant places, but this would be doing it in three pieces.

196.—THE FOUR STARS



CAN you cut the square into four pieces, all of exactly the same size and shape, each piece to contain a star, and each piece to contain one of the four central squares? The cuts must all pass along the lines, a condition that simplifies the puzzle rather than adds to its difficulty.

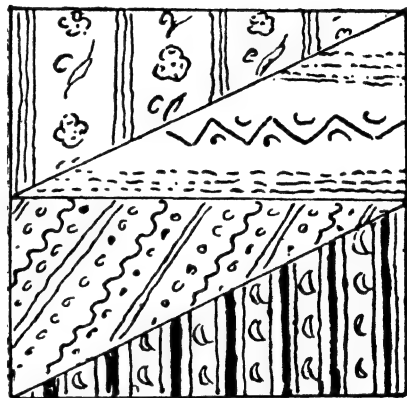
197.—ECONOMICAL DISSECTION

PROFESSOR RACKBRANE one morning produced a block of wood measuring 8 in. long by 4 in. wide by $3\frac{1}{2}$ in. deep. He asked his young friends how many pieces, each measuring $2\frac{1}{2}$ in. by $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in., could be cut out of it. He said

that most people would have more waste material left over than is necessary. How many pieces may be cut from the block?

PATCHWORK PUZZLES

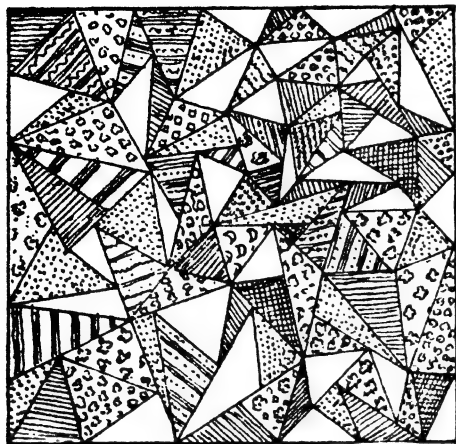
198.—THE PATCHWORK CUSHION



A LADY had twenty pieces of silk, all of the same triangular shape and size. She found that four of these would fit together and form a perfect square, as in the illustration. How was she to fit together these twenty pieces to form a perfectly square patchwork cushion? There must be no waste, and no allowance need be made for turnings.

199.—THE HIDDEN STAR

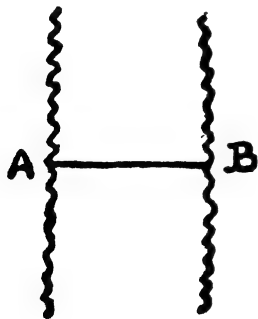
THE illustration represents a square tablecloth of choice silk patchwork. This was put together by the members of a family as a little birthday present for one of its number. One of the contributors supplied a portion in the form of a perfectly symmetrical star,



and this has been worked in exactly as it was received. But the triangular pieces so confuse the eye that it is quite a puzzle to find the hidden star. Can you discover it, so that, if you wished, by merely picking out the stitches, you could extract it from the other portions of the patchwork?

VARIOUS GEOMETRICAL PUZZLES

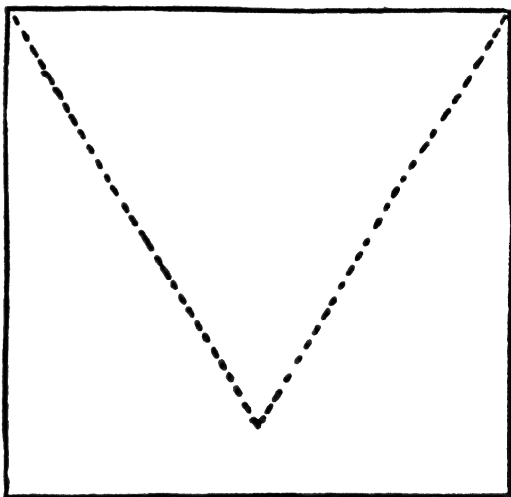
200.—MEASURING THE RIVER



A TRAVELLER reaches a river at the point A, and wishes to know the width across to B. As he has no means of crossing the river, what is the easiest way of finding its width?

201.—SQUARE AND TRIANGLE

TAKE a perfectly square piece of paper, and so fold it as to form the largest possible equilateral triangle. A triangle in which the sides are the same length as those of the square, as shown in our diagram, will not be the largest possible. Of course, no markings or measurements may be made except by the creases themselves.

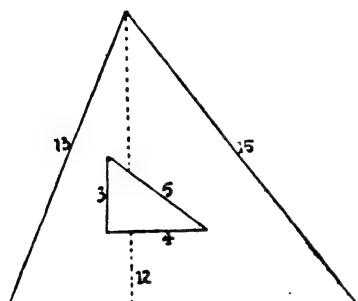


202.—A GARDEN PUZZLE

THE four sides of a garden are known to be 20, 16, 12, and 10 rods, and it has the greatest possible area for those sides. What is the area?

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203.—A TRIANGLE PUZZLE

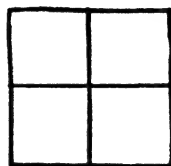


In the solution to our puzzle No. 162, we said that "there is an infinite number of rational triangles composed of three consecutive numbers like 3, 4, 5, and 13, 14, 15." We here show these two triangles. In the first case the area (6) is half of 3×4 , and in the second case, the height being 12, the area (84) is a half of 12×14 . It will be found interesting to discover such a triangle with the smallest possible three consecutive numbers for its sides, that has an area that may be exactly divided by twenty without remainder.

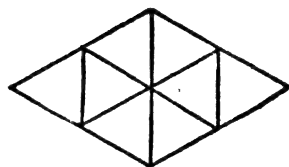
204.—THE DONJON KEEP WINDOW

In *The Canterbury Puzzles* Sir Hugh de Fortibus calls his chief builder, and, pointing to a window, says: "Methinks yon window is square, and measures, on the inside, one foot every way, and is divided by the narrow bars into four lights, measuring half a foot on every side." See our Fig. A. "I desire that another window be made higher up,

whose four sides shall also be each one foot, but it shall be divided by bars into eight lights, whose sides shall be all equal." This the craftsman was unable to do, so Sir Hugh showed him our Fig. B, which is quite correct. But he added, "I did not tell thee that the



A



B

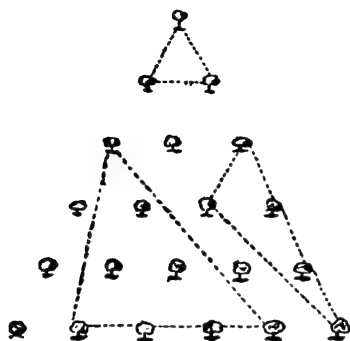
window must be square, as it is most certain it never could be."

Now, an ingenious correspondent, Mr. George Plant, found a flaw in Sir Hugh's conditions. Something that was understood is not actually stated, and the window may, as the conditions stand, be perfectly square. How is it to be done?

205.—THE SQUARE WINDOW

CRACKHAM told his family that a man had a window a yard square, and it let in too much light. He blocked up one half of it, and still had a square window a yard high and a yard wide. How did he do it?

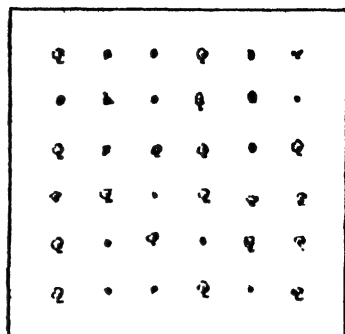
206.—THE TRIANGULAR PLANTATION



A MAN had a plantation of twenty-one trees set out in the triangular form shown in our diagram. If he wished to enclose a triangular piece of ground with a tree at each of the three angles, how many different ways of doing it are there from which he might select? The dotted lines show three ways of doing it. How many are there altogether? This is just one of those puzzles that call for the exercise of a little cunning in the solving.

207.—SIX STRAIGHT FENCES

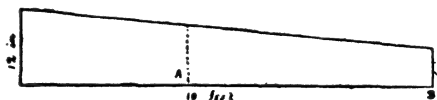
A MAN had a small plantation of thirty-six trees, planted in the form of a square. Some of these died, and had to be cut down in the positions indicated by the dots in our illustration. How is it possible to put up six straight fences across the field, so that every one of the remaining twenty trees shall be in a separate enclosure? As a matter of fact, twenty-two trees might be so enclosed by six straight fences if their positions were a little more accommodat-



ing, but we have to deal with the trees as they stand in regular formation, which makes all the difference.

Just take your pencil and see if you can make six straight lines across the field so as to leave every tree separately enclosed.

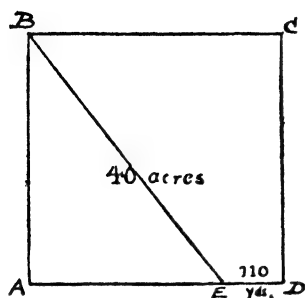
208.—DIVIDING THE BOARD



A MAN had a board measuring 10 ft. in length, 6 in. wide at one end, and 12 in. wide at the other, as shown in the illustration. How far from B must the straight cut at A be made in order to divide it into two equal pieces?

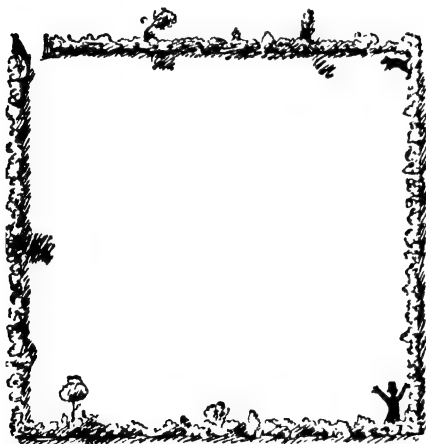
209.—A RUNNING PUZZLE

ABCD is a square field of forty acres. The line BE is a straight path, and E is 110 yards from D. In a race Adams runs direct from A to D, but Brown has to start from B, go from B to E, and thence to D. Each keeps to a uniform speed



throughout, and when Brown reaches E, Adams is 30 yards ahead of him. Which wins the race, and by how much?

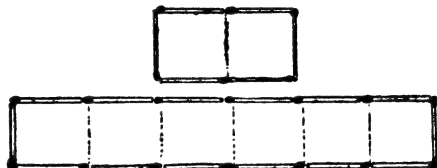
210.—PAT AND HIS PIG



Our diagram represents a field 100 yards square. Pat and the pig that he wishes to catch are in opposite corners, 100 yards apart. The pig runs straight for the gateway in the top left-hand corner. As the Irishman can run just twice as fast as the pig, you would expect that he would first make straight for the gate and close it. But this is

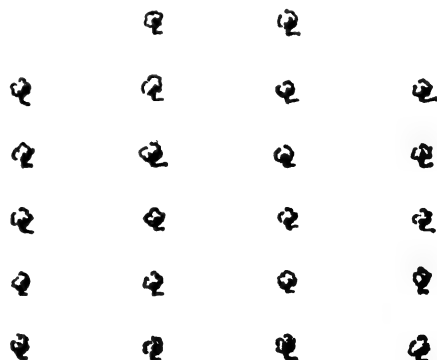
not Pat's way of doing things. He goes directly for the pig all the time, thus taking a curved course. Now, does the pig escape, or does Pat catch it? And if he catches it, exactly how far does the pig run?

211.—THE TWENTY MATCHES



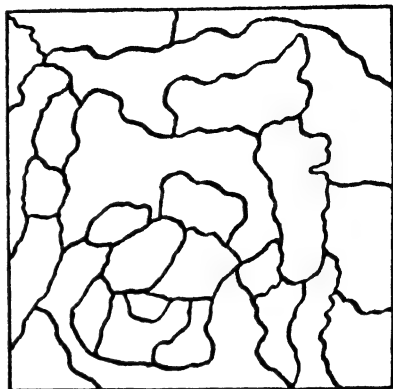
The illustration shows how twenty matches, divided into two groups of fourteen and six, may form two enclosures so that one space enclosed is exactly three times as large as the other. Now divide the twenty matches into two groups of thirteen and seven, and with them again make two enclosures, one exactly three times as large as the other.

212.—TRANSPLANTING THE TREES

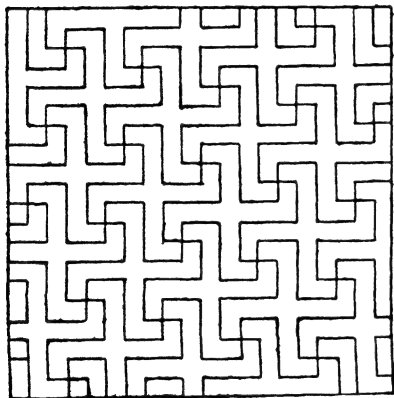


PUZZLES AND CURIOUS PROBLEMS

A MAN has a plantation of twenty-two trees arranged in the manner here shown. How is he to transplant only six of the trees so that they shall then form twenty rows with four trees in every row?



213.—A SWASTIKLAND MAP



HERE is a puzzle that the reader will probably think he has solved at almost the first glance. But will he be correct? Swastikland is divided in the manner shown in our illustration. The Lord High Keeper of the Maps was ordered so to colour this map of the country that there should be a different colour on each side of every boundary line. What was the smallest possible number of colours that he required?

looked at it for a moment, and replied, "I haven't enough colours by one in my box."

This was found to be correct. How many colours had he? He was not allowed to use black and white—only colours.

215.—THE DAMAGED RUG

A LADY had a valuable Persian rug, 12 ft. by 9 ft., which was badly damaged by fire. So she cut from the middle a



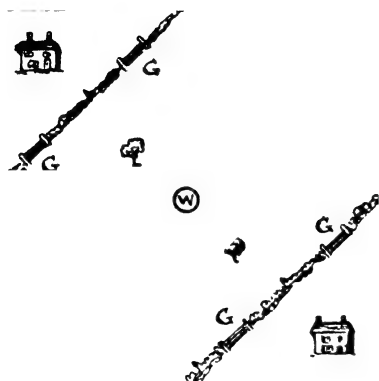
214.—COLOURING THE MAP

COLONEL CRACKHAM asked his young son one morning to colour all the twenty-six districts in this map in such a way that no two contiguous districts should be of the same colour. The lad

strip 8 ft. by 1 ft., as shown in the illustration, and then cut the remainder into two pieces that fitted together and made

a perfectly square rug 10 ft. by 10 ft. How did she do it? Of course, no allowance is to be made for turnings.

216.—THE FOUR HOUSEHOLDERS



HERE is a square plot of land with four houses, four trees, a well (W) in the centre, and hedges planted across with four gateways (G).

Can you divide the ground so that each householder shall have an equal portion of land, one tree, one gateway, an equal length of hedge, and free access to the well without trespass?

—THE THREE FENCES

"A MAN had a circular field," said Crackham, "and he wished to divide it into four equal parts by three fences, each of the same length. How might this be done?"

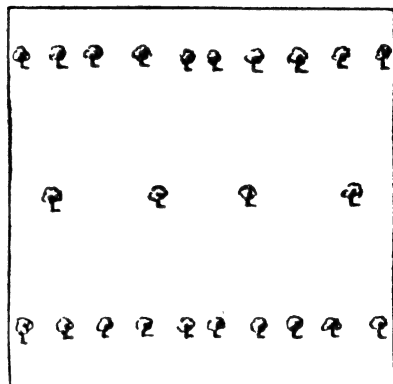
"Why did he want them of the same length?" asked Dora.

"That is not recorded," replied the Colonel, "nor are we told why he wished to divide the field into four

(8,646)

parts, nor whether the fence was of wood or iron, nor whether the field was pasture or arable. I cannot even tell you the man's name, or the colour of his hair. You will find that these points are not essential to the puzzle."

218.—THE FARMER'S SONS



A FARMER once had a square piece of ground on which stood twenty-four trees, exactly as shown in the illustration. He left instructions in his will that each of his eight sons should receive the same amount of ground and the same number of trees. How was the land to be divided in the simplest possible manner?

219.—THREE TABLECLOTHS

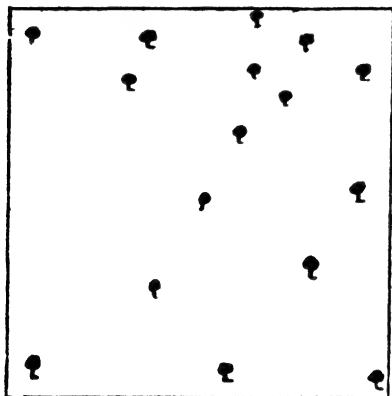
MRS. CRACKHAM at the breakfast-table recently announced that she had had as a gift from an old friend three beautiful new tablecloths, each of which is exactly 4 ft. square. She asked the members of her family if they could tell her the length of the side of the largest

PUZZLES AND CURIOUS PROBLEMS

square table top that these three cloths will together cover. They might be laid in any way so long as they cover the surface, and she only wanted the answer to the nearest inch.

220.—THE FIVE FENCES

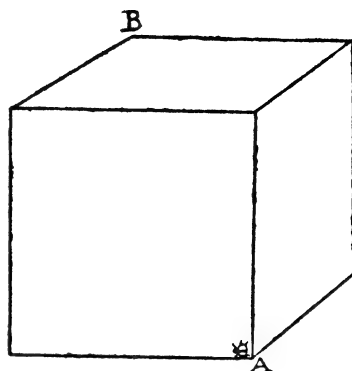
A MAN owned a large, square, fenced-in field in which were sixteen oak trees, as depicted in the illustration. He wished, for some eccentric reason, to put up



five straight fences, so that every tree should be in a separate enclosure. How did he do it? Just take your pencil and draw five straight strokes across the field, so that every tree shall be fenced off from all the others.

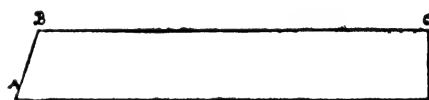
221.—THE FLY'S JOURNEY

A FLY, starting from the point A, can crawl round the four sides of the base of this cubical block in four minutes. Can you say how long it will take it to crawl from A to the opposite upper corner B?



222.—FOLDING A PENTAGON

GIVEN a ribbon of paper, as in the illustration, of any length—say more than four times as long as broad—it can be folded into a perfect pentagon, with



every part lying within the boundaries of the figure. The only condition is that the angle ABC must be the correct angle of two contiguous sides of a regular pentagon. How are you to fold it?

223.—THE TOWER OF PISA

"WHEN I was on a little tour in Italy collecting material for my book on *in the Cultivation of Macaroni*," said the Professor, "I happened to be one day on the top of the Leaning Tower of Pisa, in company with an American stranger. 'Some lean!' said my companion. 'I guess we can build a bit straighter in the States. If one of our skyscrapers bent in this way

there would be a hunt round for the architect.'

"I remarked that the point at which we leant over was exactly 179 feet from the ground, and he put to me this question: 'If an elastic ball was dropped from here, and on each rebound rose exactly one-tenth of the height from which it fell, can you say what distance the ball would travel before it came to rest?' I found it a very interesting proposition."

224.—THE TANK PUZZLE

THE area of the floor of a tank is 6 sq. ft., the water in it is 9 in. deep. How much does the water rise (1) if a 1-ft. metal cube is put in it; (2) how much farther does it rise if another cube like it is put in by its side?

225.—AN ARTIST'S PUZZLE

AN artist wished to obtain a canvas for a painting which would allow for the picture itself occupying 72 sq. in., a margin of 4 in. on top and on bottom, and 2 in. on each side. What is the smallest dimensions possible for such a canvas?

226.—THE CIRCULATING MOTOR-CAR

A MAN said that a motor-car was running on a circular track with the result that the outside wheels were going twice as fast as the inside ones.

What was the length of the circumference described by the outer wheels? The wheels were 5 ft. apart at the axle-tree.

227.—A MATCH-BOARDING ORDER

A MAN gave an order for 297 ft. of match-boarding of usual width and thickness. There were to be sixteen pieces, all measuring an exact number of feet—no fractions of a foot. He required eight pieces of the greatest length, the remaining pieces to be 1 ft., 2 ft., or 3 ft. shorter than the greatest length. How was the order carried out? Supposing the eight of greatest length were 15 ft. long, then the others must be made up of pieces of 14 ft., 13 ft., or 12 ft. lengths, though every one of these three lengths need not be represented.

228.—THE LADDER

THERE was some talk at the breakfast-table about a ladder that was needed for some domestic purposes, when Professor Rackbrane interrupted the discussion with this little puzzle:

"A ladder was fastened on end against a high wall of a building. A man unfastened it and pulled it out 4 yards at the bottom. It was then found that the top of the ladder had descended just one-fifth of the length of the ladder. What was the length of the ladder?"

229.—GEOMETRICAL PROGRES-

PROFESSOR RACKBRANE proposed, one morning, that his friends should write out a series of whole numbers in geometrical progression, starting from 1, so that the numbers should add up to a square. Thus, $1+2+4+8+16+32=63$.

But this is just one short of being a square. I am only aware of two answers in whole numbers, and these will be found easy to discover.

230.—IN A GARDEN

"My friend Tompkins loves to spring on you little puzzling questions on every occasion, but they are never very profound," said the Colonel. "I was walking round his garden with him the other day when he pointed to a rectangular flower-bed, and said: 'If I had made that bed 2 ft. broader and 3 ft. longer it would have been 64 sq. ft. larger; but if it had been 3 ft. broader and 2 ft. longer it would then have been 68 sq. ft. larger. What is its length and breadth?'"

1.—THE ROSE GARDEN

"A FRIEND of mine," said Professor Rackbrane, "has a rectangular garden, and he wants to make exactly one-half of it into a large bed of roses, with a gravel path of uniform width round it.

PATH _____

BED

Can you find a general rule that will apply equally to any rectangular garden,

garden. A plain ribbon, no shorter than the length of the garden, is all the material required."

232.—A PAVEMENT PUZZLE

Two square floors had to be paved with stones each 1 ft. square. The number of stones in both together was 2,120, but each side of one floor was 12 ft. more than each side of the other floor. What were the dimensions of the two floors?

233.—THE NOUGAT PUZZLE

A BLOCK of nougat is 16 in. long, 8 in. wide, and $7\frac{1}{2}$ in. deep. What is the greatest number of pieces that I can cut from it measuring 5 in. by 3 in. by $2\frac{1}{2}$ in.?

234.—PILE DRIVING

DURING some bridge-building operations a pile was being driven into the bed of the river. A foreman remarked that at _____ of the pile was embedded in the mud, one-third was under water, and 17 ft. 6 in. above water.

What was the length of the pile?

5.—AN EASTER EGG PROBLEM

"HERE is an appropriate Easter egg problem for you," said Professor Rackbrane at the breakfast-table. "If I have an egg measuring exactly 3 in. in length, and three other eggs all similar in shape, having together the same contents as the large egg, can you give me exact measurements for the lengths of the three smaller ones?"

AN eccentric man had a block of wood measuring 3 ft. by 1 ft. by 1 ft., which he gave to a wood-turner with instruc-

tions to turn from it a pedestal, saying that he would pay him a certain sum for every cubic inch of wood taken from the block in process of turning. The ingenious turner weighed the block and found it to contain 30 lbs. After he had finished the pedestal it was again weighed, and found to contain 20 lbs. As the original block contained 3 cubic ft., and it had lost just one-third of its weight, the turner asked payment for 1 cubic ft. But the gentleman objected, saying that the heart of the wood might be heavier or lighter than the outside. How did the ingenious turner contrive to convince his customer that he had taken not more and not less than 1 cubic ft. from the block?

237.—THE MUDBURY WAR MEMORIAL

THE worthy inhabitants of Mudbury-in-the-Marsh recently erected a war memorial, and they proposed to enclose a piece of ground on which it stands with posts. They found that if they set up the posts 1 ft. asunder they would have too few by 150. But if they placed them a yard asunder there would be too many by 70.

How many posts had they in hand?

238.—A MAYPOLE PUZZLE

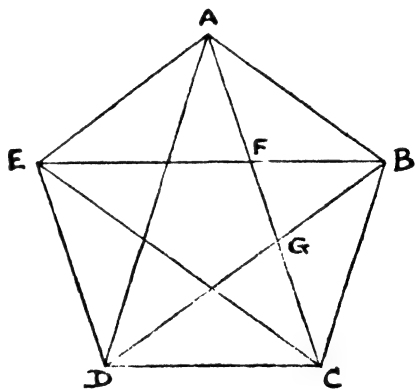
DURING a gale a maypole was broken in such a manner that it struck the level ground at a distance of 20 ft. from the base of the pole, where it entered the earth. It was repaired, and broken by the wind a second time at a point 5 ft.

lower down, and struck the ground at a distance of 30 ft. from the base. What was the original height of the pole? In neither case did the broken part become actually detached.

239.—THE BELL ROPE

A BELL rope, passing through the ceiling above, just touches the belfry floor, and when you pull the rope to the wall, keeping the rope taut, it touches a point just 3 in. above the floor, and the wall was 4 ft. from the rope when it hung at rest. How long was the rope from floor to ceiling?

240.—COUNTING THE TRIANGLES



PROFESSOR RACKBRANE has just given

of those that interested his party at Christmas. Draw a pentagon, and connect each point with every other point by straight lines, as in the diagram. How many different triangles are contained in this figure? To make it quite clear, AFB, AGB, ACB, BFG, BFC,

and BGC, are six such triangles. It is not a difficult count if you proceed with some method, but otherwise you are likely to drop triangles or include some more than once.

241.—A HURDLES PUZZLE

THE answers given in the old books to some of the best-known puzzles are often clearly wrong. Yet nobody ever seems to detect their faults. Here is an example. A farmer had a pen made of fifty hurdles, capable of holding a hundred sheep only. Supposing he wanted to make it sufficiently large to hold double that number, how many additional hurdles must he have?

Perhaps our readers might be interested in making a list of old puzzles that are wrong.

242.—CORRECTING A BLUNDER

MATHEMATICS is an exact science, but first-class mathematicians are apt, like



the rest of humanity, to err badly on occasions. On referring to Peter Barlow's valuable work on *The Theory of Numbers*, we hit on this problem:

"To find a triangle such that its three sides, perpendicular, and the line drawn from one of the angles bisecting the base may be all expressed in rational numbers." He gives as his answer the triangle 480, 299, 209, which is wrong and entirely unintelligible.

Readers may like to find a correct solution when we say that all the five measurements may be in whole numbers, and every one of them less than a hundred. It is apparently intended that the triangle must not itself be right-angled.

243.—THE SQUIRREL'S CLIMB

A SQUIRREL goes spirally up a cylindrical post, making the circuit in 4 ft. How many feet does it travel to the top if the post is 16 ft. high and 3 ft. in circumference?

244.—SHARING A GRINDSTONE

THREE men bought a grindstone 20 in. in diameter. How much must each grind off so as to share the stone equally, making an allowance of 4 in. off the diameter as waste for the aperture? We are not concerned with the unequal value of the shares for practical use—only with the actual equal quantity of stone each receives.

MOVING COUNTER PROBLEMS

MOVING COUNTER PROBLEMS

245.—MAGIC FIFTEEN PUZZLE

THIS is Loyd's famous 14-15 puzzle, in which you were asked to get the 14 and 15 in their proper order by sliding the blocks about in the box. It was, of course, impossible of solution. I now propose to slide them about until they

beyond, if vacant, either horizontally or vertically, but not diagonally, and there

B

shall form a perfect magic square in which the four columns, four rows, and two diagonals all add up to 30. It will be found convenient to use numbered counters in place of the blocks. What are your fewest possible moves?

246.—TRANSFERRING THE COUNTERS

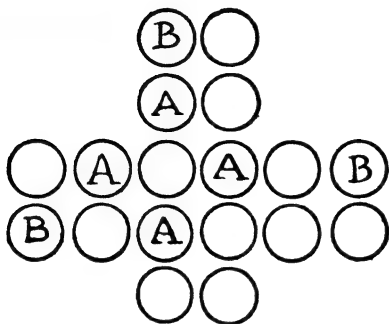
PLACE ten counters on the squares of a chessboard as here shown, and transfer them to the other corner as indicated by the ten crosses. A counter may jump over any counter to the next square

are no captures and no simple moves—only leaps. Not to waste the reader's time we give a conclusive proof that it is impossible. You are now asked to add two more counters so that it may be done. If you place these, say, on AA, they must, in the end, be found in the corresponding positions BB. Where will you place them?

247.—THE COUNTER CROSS

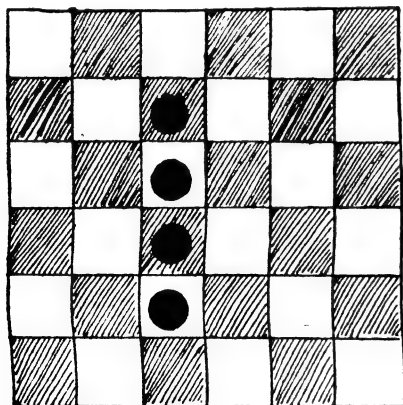
ARRANGE twenty counters in the form of a cross, in the manner shown in the diagram. Now, in how many different ways can you point out four counters that will form a perfect square if considered alone? Thus the four counters

composing each arm of the cross, and also the four in the centre, form squares.



Squares are also formed by the four counters marked A, the four marked B, and so on. And how may you remove six counters so that not a single square can be so indicated from those that remain?

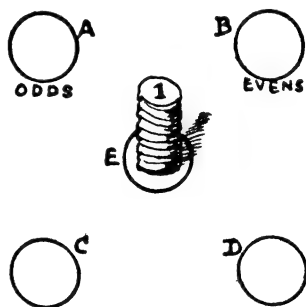
248.—FOUR IN LINE



We have a board of thirty-six squares, and four counters are so placed in a straight line that every square of

the board is in line horizontally, vertically, or diagonally with at least one counter. In other words, if you regard them as chess queens, every square on the board is attacked by at least one queen. The puzzle is to find in how many different ways the four counters may be placed in a straight line so that every square shall thus be in line with a counter. Every arrangement in which the counters occupy a different set of four squares is a different arrangement. Thus, in the case of the example given, they can be moved to the next column to the right with equal effect, or they may be transferred to either of the two central rows of the board. This rearrangement, therefore, produces four solutions by what we call reversals or reflections of the board. Remember that the counters must always be disposed in a straight line. It will be found an entertaining little puzzle.

249.—ODDS AND EVENS



PLACE eight counters in a pile on the middle circle so that they shall be in proper numerical order, with 1 on the

top and 8 at the bottom. It is required to transfer 1, 3, 5, 7 to the circle marked ODDS, and 2, 4, 6, 8 to the circle marked EVENS. You can only move one counter at a time from circle to circle, and you must never place a number on a smaller number, nor an odd and an even number together on the same circle. That is to say, you may place the 1 on the top of the 3, or the 3 on the top of the 7, or the 2 on the 6, or the 2 on the 4, but you must not place the 1 on the 2, or the 4 on the 7, as that would be an odd and even together. What are the fewest possible moves?

250.—ADJUSTING THE COUNTERS

PLACE twenty-five counters in a square in the order shown. Then it is a good puzzle to put them all into regular

order so that the first line reads 1 2 3 4 5, and the second 6 7 8 9 10, and so on to the end, by taking up one counter in each hand and making them change places. Thus you might take up 7 and 1 and replace them as 1 and 7. Then take up 24 and 2 and make them also change places, when you will have the first two counters properly placed. The puzzle is to determine the fewest possible exchanges in which this can be done.

251.—NINE MEN IN A TRENCH

(Diagram at foot of page.)

HERE are nine men in a trench. No. 1 is the sergeant, who wishes to place himself at the other end of the line—at point 1—all the other men returning to their proper places as at present. There is no room to pass in the trench, and for a man to attempt to climb over another would be a dangerous exposure. But it is not difficult with those three recesses, each of which will hold a man. How is it to be done with the fewest possible moves? A man may go any distance that is possible in a move.

252.—BLACK AND WHITE

ONE morning Rackbrane showed his friends this old puzzle. Place four

white and four black counters alternately in a row as here shown. The

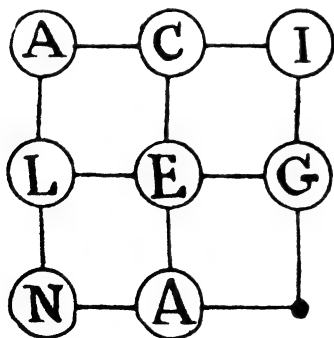


puzzle is to transfer two contiguous counters to one end then move two contiguous counters to the vacant space, and so on until in four such moves they form a continuous line of four black counters followed by four white ones. Remember that two counters moved must always be contiguous ones.

"Now," he said, "as you know how to do that, try this variation. The conditions are exactly the same, only in moving a contiguous pair you must make them change sides. Thus, if you move 5, 6, to the end, you must replace them in the order 6, 5. How many moves will you now require?"

253.—THE ANGELICA PUZZLE

HERE is a little puzzle that will soon become quite fascinating if you attempt



it. Draw a square with three lines in both directions and place on the inter-

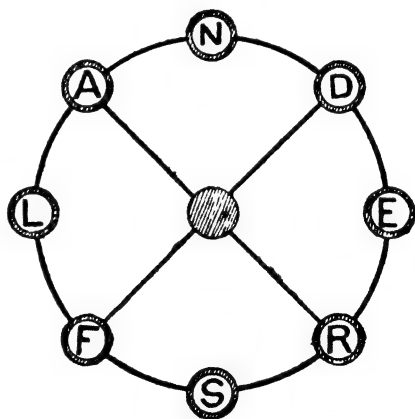
secting points eight lettered counters as shown in our illustration. The puzzle is to move the counters, one at a time, along the lines from point to vacant point until you get them in the order ANGELICA thus :

A	N	G
E	L	I
C	A	

Try to do this in the fewest possible moves. It is quite easy to record your moves, as you merely have to write the letters thus, as an example : A E L N, etc.

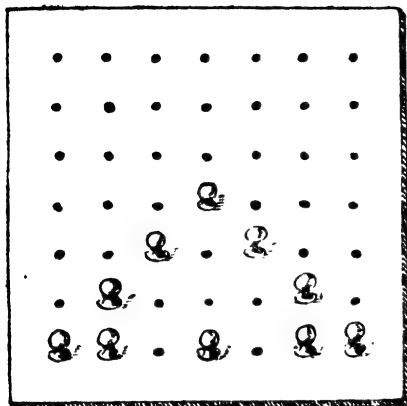
254.—THE FLANDERS WHEEL

PLACE eight lettered counters on the wheel as shown. Now move them one



at a time along the lines from circle to circle until the word FLANDERS can be correctly read round the rim of the wheel as at present, only that the F is in the upper circle now occupied by the N. Of course two counters cannot be in a circle at the same time. Find the fewest possible moves.

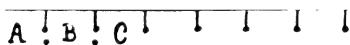
255.—A PEG PUZZLE



THE illustration represents a square mahogany board with forty-nine holes in it. There are ten pegs to be placed in the positions shown, and the puzzle is to remove only three of these pegs to different holes, so that the ten shall form five rows with four pegs in every row. Which three would you move, and where would you place them?

256.—CATCHING THE PRISONERS

MAKE a rough diagram on a sheet of paper, and use counters to indicate the

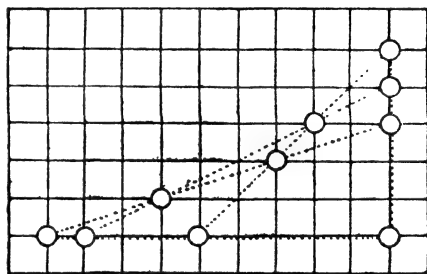


two warders (the men in peaked caps) and the two prisoners. At the beginning

the counters must be placed in the squares shown. The first player moves each of the warders through a doorway to the next cell, in any direction. Then the second player moves each prisoner through a doorway to an adjoining cell; and so on until each warder captures his prisoner. If one warder makes a capture, both he and his captive are out of the game, and the other pair continue alone.

Thus (taking only one side, just for illustration of the moves), the warder on the left may go to F, then the prisoner to D, then the warder to E, then the prisoner to A, the warder to B, the prisoner to D, and so on. You come to the conclusion that it is a hopeless chase, but it can really be done if you use a little cunning.

257.—FIVE LINES OF FOUR



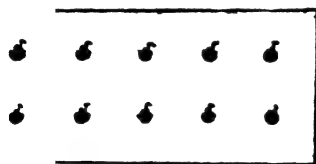
THE illustration shows how ten counters may be placed on the points of the diagram where the lines intersect, so that they form five straight lines with four counters in every line, as indicated by the dotted lines. Can you find a second way of doing this?

Of course a mere reversal or reflection

of the given arrangement is not considered different—it must be a new scheme altogether, and of course you cannot increase the dimensions of the diagram or alter its shape.

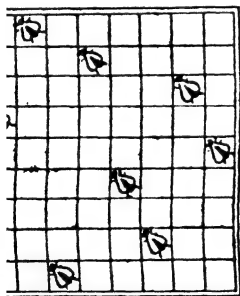
258.—DEPLOYING BATTLESHIPS

TEN battleships were anchored in the form here shown. The puzzle is for four ships to move to new positions (the



others remaining where they are) until the ten form five straight rows with four ships in every row. How should the admiral do it?

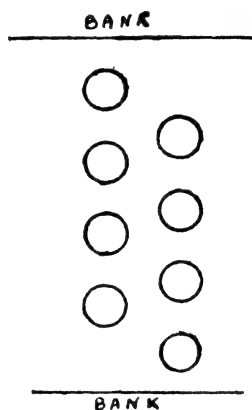
259.—FLIES ON WINDOW PANES



HERE is a window with eighty-one panes. There are nine flies on as many panes, and no fly is in line with another one horizontally, vertically, or diagonally.

Six of these flies are very torpid and do not move, but each of the remaining three goes to an adjoining pane. And yet, after this change of station, no fly is in line with another. Which are the three lively flies, and to which three panes (at present unoccupied) do they pass?

260.—STEPPING-STONES

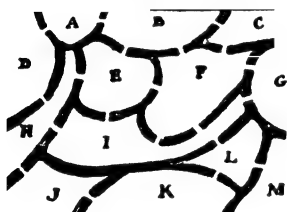


THE illustration represents eight stepping-stones across a certain stream. The puzzle is to start from the lower bank and land twice on the upper bank (stopping there), having returned once to the lower bank. But you must be careful to use each stepping-stone the same number of times. In how few steps can you make the crossing? Make the steps with two fingers in the diagram, and you will see what a very simple matter it is. Yet it is more than likely that you will at first take a great many more steps than are necessary.

UNICURSAL AND ROUTE PROBLEMS

UNICURSAL AND ROUTE PROBLEMS

261.—THE TWENTY-TWO BRIDGES



We have here a rough map of a district with an elaborate system of irrigation, as the various waterways and numerous bridges will show. A man set out from one of the lettered departments to pay a visit to a friend living in a different department. For the purpose of pedestrian exercise he crossed every one of the bridges once, and once only. The puzzle is to show in which two departments their houses are situated. It is exceedingly easy if you give it a few moments' thought. You must not, of course, go outside the borders of the diagram.

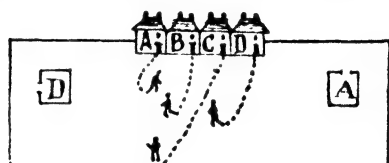
262.—A MONMOUTH TOMBSTONE

(Diagram on next page.)

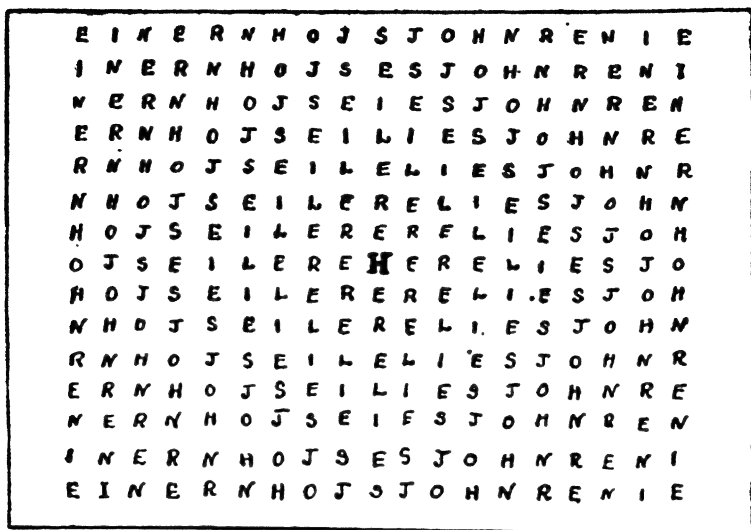
IN the burial ground attached to St. Mary's Church, Monmouth, is this arrangement of letters on one of the tombstones. In how many different

ways can these words "HERE LIES JOHN RENIE" be read, starting at the central H and always passing from one letter to another that is contiguous?

263.—FOOTPRINTS IN THE SNOW



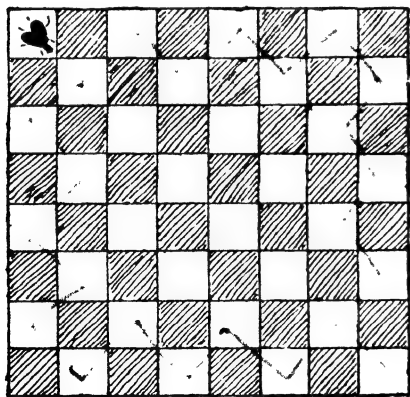
FOUR schoolboys, living respectively in the houses A, B, C, and D, attended different schools. After a snowstorm one morning their footprints were examined, and it was found that no boy had ever crossed the track of another boy, or gone outside the square boundary. Take your pencil and continue their tracks, so that the boy A goes to the school A, the boy B to the school B, and so on, without any line crossing another line.



A MONMOUTH TOMBSTONE

264.—THE FLY'S TOUR

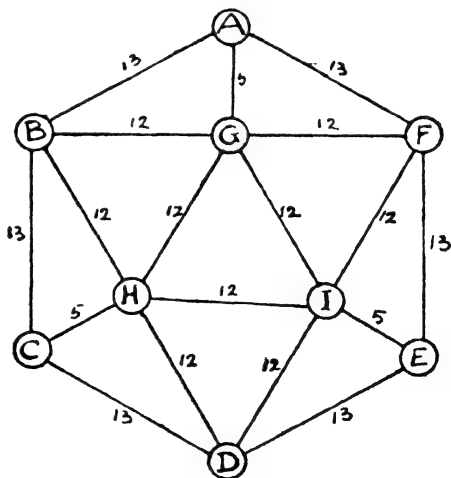
A FLY pitched on the square in the top left-hand corner of a chessboard, and then proceeded to visit every white square.



square. He did this without ever entering a black square or ever passing through the same corner more than once.

Can you show his route? It can be done in seventeen continuous straight courses.

265.—INSPECTING THE ROADS



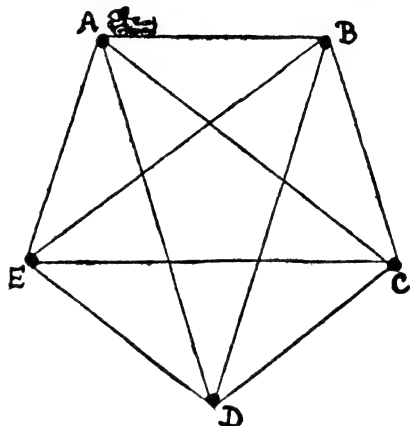
A MAN starting from the town A, has to inspect throughout all the roads shown from town to town. Their respective lengths, 13, 12, and 5 miles, are all shown. What is the shortest possible route he can adopt, ending his journey wherever he likes?

266.—RAILWAY ROUTES

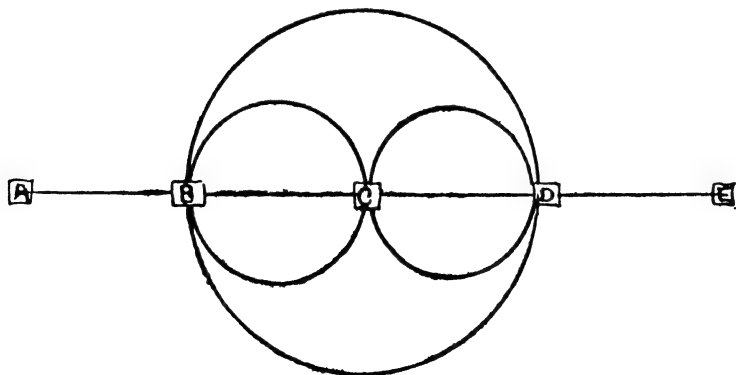
THE diagram below represents a simplified railway system, and we want to know how many different ways there are of going from A to E, if we never go twice along the same line in any journey. This is a very simple proposition, but practically impossible of solution until you have hit on some method of recording the routes. You see there are many ways of going, from the short route ABDE, taking one of the large loops, up to the long route ABCDBCD-BCDE, which takes you over every line on the system, and can itself be varied in order in many ways. Now, how many different ways of going are there?

267.—A MOTOR-CAR TOUR

A MAN started in a motor-car from the town A, and wished to make a complete tour of these roads, going along every one of them once, and once only. How



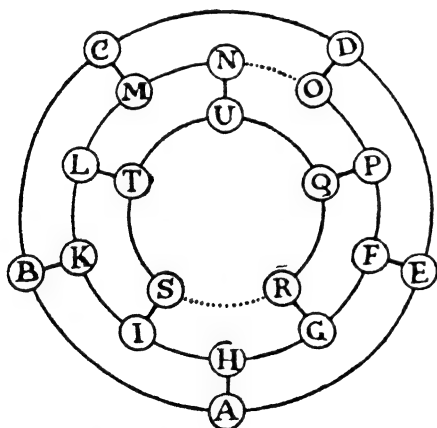
many different routes are there from which he can select? It is puzzling unless you can devise some ingenious method. Every route must end at the town A, from which you start, and you must go straight from town to town—never turning off at crossroads.



268.—MRS. SIMPER'S HOLIDAY TOUR

THE illustration represents a plan, very much simplified, of a tour that my friend Mrs. Simper proposes to make next autumn. It will be seen that there are twenty towns all connected by lines of railways. Mrs. Simper lives at the town marked H, and she wants to visit every one of the other towns once, and once only, ending her tour at home.

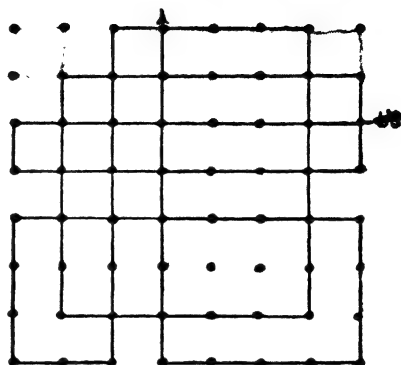
It may interest the reader to know that there are just sixty different routes from which she may select, counting the reverse way of a route as different. There is a tunnel between N and O, and another between R and S, and the good lady objects very much to going through these. She also wants to delay her visit to D as long as possible in order to meet



the convenience of a friend who resides there. Now, the puzzle is to show Mrs. Simper her very best route in these circumstances.

269.—SIXTEEN STRAIGHT RUNS

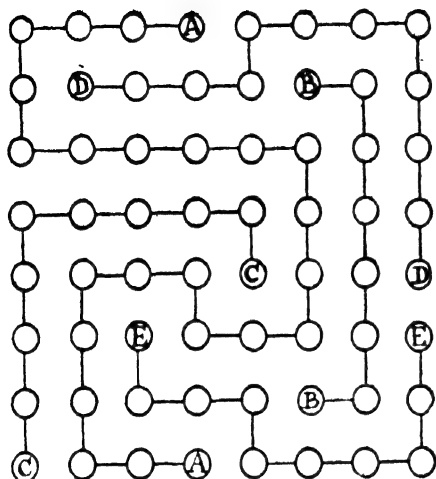
A COMMERCIAL traveller started in his car from the point shown, and wished



to go 76 miles in sixteen straight runs, never going along the same road twice. The dots represent towns and villages, and these are one mile apart. The lines show the route he selected. It will be seen that he carried out his plan correctly, but six towns or villages were unvisited. Can you show a better route by which he could have gone 76 miles in sixteen straight runs, and left only three towns unvisited?

270.—PLANNING TOURS

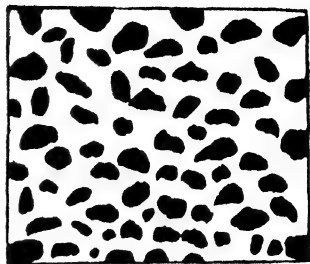
THE illustration represents a map (considerably simplified for our purposes) of a certain district. The circles are towns and villages, and the lines roads. Can you show how five motor-car drivers can go from A to A, from B to B, from C to C, from D to D, from E to E, respectively, without one ever crossing the track or going along the same road as another car? Just take your pencil



and mark the routes you propose, and you will probably find it a little puzzling. Of course it makes no difference which of two similar letters is the starting-place, because we are only concerned with the routes joining them. You see, if you take the route straight down from A to A you will have barred out every possible route for the other cars, with the exception of B to B, because, of course, the drivers are restricted to the roads shown on the map.

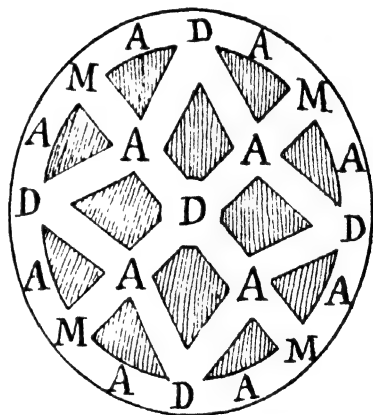
271.—AVOIDING THE MINES

HERE we have a portion of the North Sea thickly sown with mines by the enemy. A cruiser made a safe passage through them from south to north in two straight courses, without striking a single mine. Take your pencil and try to discover how it is done. Go from



the bottom of the chart to any point you like on the chart in a straight line, and then from that point to the top in another straight line without touching a mine.

272.—A MADAM PROBLEM



IN how many different ways is it possible to read the word "MADAM" in the diagram? You may go as you please, upwards and downwards, forwards and backwards, any way possible along the open paths. But the letters in every case must be contiguous, and you may never pass a letter without using it.

COMBINATION AND GROUP PROBLEMS

COMBINATION AND GROUP PROBLEMS

273.—CITY LUNCHEONS

THE clerks attached to the firm of Pilkins and Popinjay arranged that three of them would lunch together every day at a particular table so long as they could avoid the same three men sitting down twice together. The same number of clerks of Messrs. Radson, Robson, and Ross decided to do precisely the same, only with four men at a time instead of three. On working it out they found that Radson's staff could keep it up exactly three times as many days as their neighbours. What is the least number of men there could have been in each staff?

274.—HALFPENNIES AND TRAY

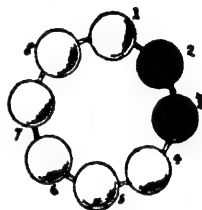
WHAT is the greatest number of halfpennies that can be laid flat on a circular tray (with a small brim to prevent overlapping the edge) of exactly 9 in. in diameter, inside measurements? No halfpenny may rest, however slightly, on another. Of course, everybody should know that a halfpenny is exactly one inch in diameter.

275.—THE NECKLACE PROBLEM

How many different necklaces can be made with eight beads, where each bead

(8,646)

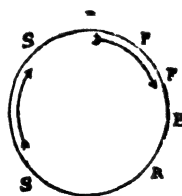
may be either black or white, the beads being indistinguishable except by colour? Thus we may have eight white or eight black, or seven white and one black, or six white and two black, as in our



tion, and so on. Of course, if you exchange black No. 3 with 4, or with 5, or with 6, you get different necklaces. But if you exchange 3 with 7 it will be the same as 3 with 5, because it is merely turning the necklace over. So we have to beware of counting such repetitions as different. The answer is a much smaller one than the reader may

276.—AN EFFERVESCENT PUZZLE

IN how many different ways can the letters in the word EFFERVESCES be arranged in a line without two E's ever appearing together? Of course similar let-



identity, so that to interchange them will make no difference. When the

reader has done this he should try the case where the letters have to be arranged differently in a circle, as shown, with no two E's together. We are here, of course, only concerned with the order of the letters and not with their positions on the circumference, and you must always read in a clockwise direction, as indicated by the arrow.

278.—THE THIRTY-SIX LETTER PUZZLE

A|B

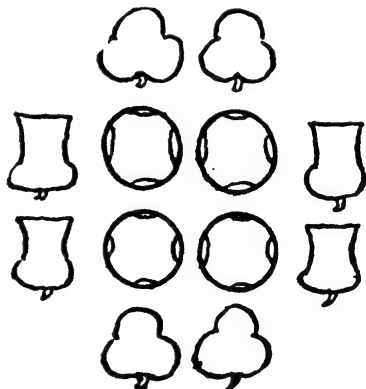
277.—TESSELLATED TILES

HERE we have twenty tiles, all coloured with the same four colours, and the order

If you try to fill up this square by repeating the letters A, B, C, D, E, F, so that no A shall be in a line, across, downwards or diagonally, with another A, no B with another B, no C with another C, and so on, you will find that it is impossible to get in all the thirty-six letters under these conditions. The puzzle is to place as many letters as possible. Probably the reader will leave more blank spaces than there need be.

of the colouring is indicated by the shadings: thus, the white may represent white; the black, blue; the striped, red; and the dotted, yellow. The puzzle is to select any sixteen of these tiles that you choose and arrange them in the form of a square, always placing similar colours together—white against white, red against red, and so on. It is quite easy to make the squares in paper or cardboard, and colour them according to taste, but the order of the colours must be exactly as shown in the illustration.

279.—ROSES, SHAMROCKS, AND



PLACE the numbers 1 to 12 (one number in every design) so that they shall add up to the same sum in the following seven different ways—viz., each of the two centre columns, each of the two central rows, the four roses together, the four shamrocks together, and the four thistles together.

280.—THE TEN BARRELS

A MERCHANT had ten barrels of sugar, which he placed in the form of a pyramid, as shown. Every barrel bore a different number, except one, which was not marked. It will be seen that he had accidentally arranged them so that the

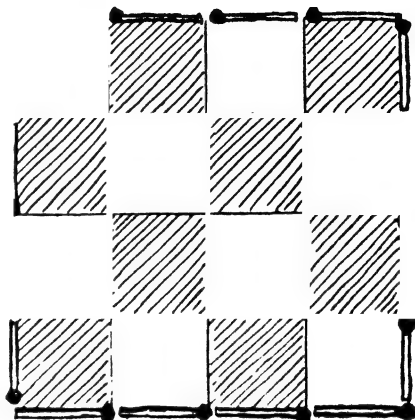


numbers in the three sides added up alike—that is, to 16. Can you rearrange them so that the three sides shall sum to the smallest number possible? Of course the central barrel (which happens to be 7 in the illustration) does not come into the count.

281.—A MATCH PUZZLE

THE sixteen squares of a chessboard are enclosed by sixteen matches. It is

required to place an *odd* number of matches inside the square so as to en-

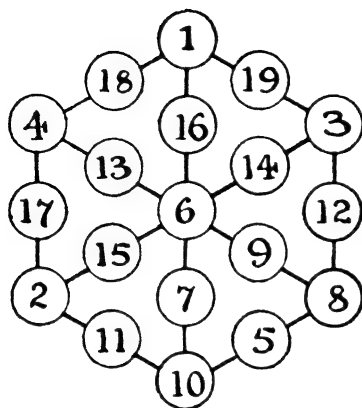


close four groups of four squares each. There are obvious and easy ways of doing it with 8, 10, or 12 matches, but these are *even* numbers. It may only take the reader a few moments to discover the four distinctive ways (mere reversals and reflections not counting as different) of doing it with an odd number of matches. Of course no duplicated matches are allowed.

282.—THE MAGIC HEXAGON

IN the illustration on p. 92 it will be seen how we have arranged the numbers 1 to 19 so that all the twelve lines of three add up 23. Six of these lines are, of course, the six sides, and the other six lines radiate from the centre. Can find a different

will still add up 23 in all the twelve directions? There is only one such arrangement to be found.



THE MAGIC HEXAGON

283.—PAT IN AFRICA

SOME years ago ten of a party of explorers fell into the hands of a savage chief, who, after receiving a number of gifts, consented to let them go after half of them had been flogged by the

Murphy (No. 1) was given a number to count round and round in the direction he is pointing. When that number fell on a man he was to be taken out for flogging, while the counting went on from where it left off until another man fell out, and so on until the five had been selected for punishment. If Pat had remembered the number correctly, and had begun at the right man, the flogging would have fallen upon all the five natives. But poor Pat mistook the number and began at the wrong man, with the result that the Britishers all got the flogging and the natives escaped. Can you find (1) the number the Irishman selected and the man at whom he began to count, and (2) the number he ought to have used and the man at whom the counting ought to have begun? The smallest possible number is required in each.



284.—LAMP SIGNALLING

Two spies on the opposite sides of a river contrived a method for signalling by night. They each put up a stand, like our illustration, and each possessed

Chief Medicine Man. There were five Britons and five native carriers, and the former planned to make the flogging fall on the five natives. They were all arranged in a circle in the order shown in the illustration, and Pat

three lamps which could show either white, red, or green light. They con-

structed a code in which every different signal meant a sentence. You will, of course, see that a single lamp hung on any one of the hooks could only mean the same thing, that two lamps hung on the upper hooks 1 and 2 could not be distinguished from two on 4 and 5. Of course, two red lamps on 1 and 5 could be distinguished from two on 1 and 6. And two on 1 and 2 would be different from two on 1 and 3. Now, remembering the variations of colour as well as of position, what is the greatest number of signals that could be sent?

285.—THE TEASHOP CHECK

_____ $\frac{1}{2}d$ _____ ●
 _____ $1d$ _____
 _____ $1\frac{1}{2}d$ _____
 _____ $2d$ _____
 _____ $2\frac{1}{2}d$ _____
 ● _____ $3d$ _____
 _____ $4d$ _____
 _____ $6d$. _____
 _____ $7d$ _____
 _____ $8d$ _____
 _____ $1s$ _____

WE give an example of the check supposed to be employed at certain popular teashops. The waitress punches holes in the tickets to indicate the amount of the purchase. Thus, in our example,

the two holes indicate that the customer has to pay $3\frac{1}{2}d$. But the girl might, if she had chosen, have punched in any one of three other ways— $2\frac{1}{2}d$. and $1d$., $2d$. and $1\frac{1}{2}d$., $2d$. $1d$. and $\frac{1}{2}d$. On one occasion a waitress said, "I find I can punch my customer's ticket in any one of ten different ways, *and no more*." "Then," replied the second girl, "I can say exactly the same in the case of my customer." This was true. What were the amounts of the purchases, which were different? Only one hole is allowed to be punched against the same amount.

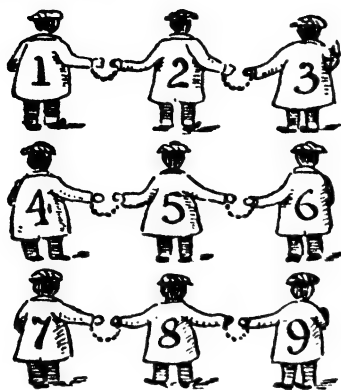
286.—UNLUCKY BREAKDOWNS

ON an occasion of great festivities a considerable number of townspeople banded together for a day's outing and pleasure. They pressed into service nearly every wagon in the place, and each wagon was to carry the same number of persons. Half-way ten of these wagons broke down, so it was necessary for every remaining wagon to carry one more person. Unfortunately, when they started for home, it was found that fifteen more wagons were in such bad condition that they could not be used; so there were three more persons in every wagon than when they started out in the morning. How many persons were there in the party?

287.—THE HANDCUFFED PRISONERS

ONCE upon a time there were nine prisoners of particularly dangerous char-

acter who had to be carefully watched. Every week-day they were taken out for



exercise, handcuffed together, as shown in the sketch made by one of their guards. On no day in any one week were the same two men to be handcuffed together. It will be seen how they were sent out on Monday. Can you arrange the nine men in triplets for the remaining five days? It will be seen that No. 1 cannot again be handcuffed to No. 2 (on either side), nor No. 2 with No. 3, but,

of course, No. 1 and No. 3 can be put together. Therefore, it is quite a different problem from the old one of the Fifteen Schoolgirls, and it will be found to be a fascinating teaser and amply repay for the leisure time spent on its solution.

288.—SEATING THE PARTY

As the Crackham family were taking their seats on starting out on their tour Dora asked in how many different ways they could all be seated, as there were six of them and six seats—one beside the driver, two with their backs to the driver, and two behind, facing the driver—if no two of the same sex are ever to sit side by side? As the Colonel, Uncle Jabez, and George were the only ones who could drive, it required just a little thinking out. Perhaps the reader will like to work out the answer concerning which they were all agreed at the end of the day.

**MAGIC SQUARE, MEASURING, WEIGHING,
AND PACKING PROBLEMS**

MAGIC SQUARE, MEASURING, WEIGHING, AND PACKING PROBLEMS

289.—MAGIC SQUARE TRICK

HERE is an advertising trick that appeared in America many years ago. Place in the empty squares such figures (different in every case, and no two

ber that the numbers together must contain nine of each figure 1, 2, 3, 4, and

1234 1234

1234 1234

1234

squares containing the same figure) so that they shall add up 15 in as many straight directions as possible. A large prize was offered, but no correct solution received. Can the reader guess the ?

290.—A FOUR-FIGURE MAGIC SQUARE

IN this square, as every cell contains the same number—1 2 3 4—the three columns, three rows, and two long diagonals naturally add up alike. The puzzle is to form and place nine different four-figure numbers (using the same figures) so that they also shall form a perfect magic square. Remem-

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ber that they must be four-square numbers without fractions or trick of any kind.

291.—

(Diagram on next page.)

THIS is a magic square, adding up 287 in every row, every column, and each of

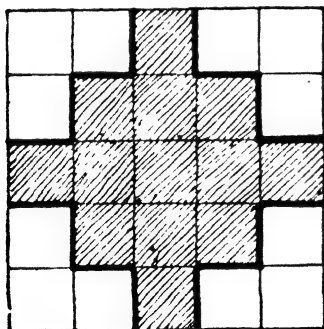
outer margin of numbers we have another square giving sums of 205. If we again remove the margin there is left a magic square adding up 123. Now fill up the vacant spaces in the diagram with such numbers from 1 to 81 inclusive as have not already been given, so that there shall be formed a magic square adding up 369 in each of twenty directions.

20 55|30|57 26
 31 50|29 60 35|68|
 46|38|45|40|36|24|
 65|33|43|41 39|49|17
 64|48 42
 10 47 32 53 22 51
 56 52 25 11 62|

PROGRESSIVE SQUARES

292.—CONDITIONAL MAGIC SQUARE

THOUGH there is nothing new to be said about the mere construction of a perfect magic square, and the subject has a very large, though scattered, literature of its own, a little variation that has some



fresh condition is generally welcome. Here is a not difficult example. Can you form a magic square with all the columns, rows, and two long diagonals, adding up alike, with the numbers 1 to 25 inclusive, placing only the odd num-

bers on the shaded squares in our diagram, and the even numbers on the other squares? There are a good many solutions. Can you find one of them?

293.—THE TWENTY PENNIES

IF sixteen pennies are arranged in the form of a square there will be the same number of pennies in every row, column, and each of the two long diagonals. Can you do the same with twenty pennies?

294.—THE KEG OF WINE

A MAN had a 10-gallon keg of wine and a jug. One day he drew off a jugful of wine and filled up the keg with water. Later on, when the wine and water had got thoroughly mixed, he drew off another jugful, and again filled up the keg with water. The keg then contained equal quantities of wine and water. What was the capacity of the jug?

295.—BLENDING THE TEAS

A GROCER buys two kinds of tea—one at 2s. 8d. per pound, and the other, a better quality, at 3s. 4d. a pound. He mixes together some of each, which he proposes to sell at 3s. 7d. a pound, and so make a profit of 25 per cent. on the cost. How many pounds of each kind must he use to make a mixture of a hundred pounds weight?

296.—WATER MEASUREMENT

A MAID was sent to the brook with two vessels that exactly measured 7 pints

and 11 pints respectively. She had to bring back exactly 2 pints of water. What is the smallest possible number of transactions necessary? A "transaction" is filling a vessel, or emptying it, or pouring from one vessel to another.

297.—MIXING THE WINE

A GLASS is one-third full of wine, and another glass, with equal capacity, is one-fourth full of wine. Each is filled with water and their contents mixed in a jug. Half of the mixture is poured into one of the glasses. What proportion of this is wine and what part water?

298.—THE STOLEN BALSAM

THREE men robbed a gentleman of a vase containing 24 ounces of balsam. While running away, they met in a forest a glass seller, of whom, in a great hurry, they purchased three vessels. On reaching a place of safety they wished to divide the booty, but they found that their vessels contained 5, 11, and 13 ounces respectively. How could they divide the balsam into equal portions?

299.—THE WEIGHT OF THE FISH

THE Crackhams had contrived that their tour should include a certain place where there was good fishing, as Uncle Jabez was a good angler and they wished to give him a day's sport. It was a charming spot, and they made a picnic of the occasion. When their

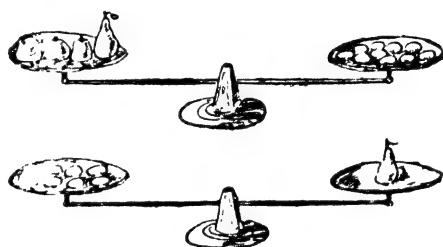
uncle landed a fine salmon trout there was some discussion as to its weight. The Colonel put it into the form of a puzzle, saying:

"Let us suppose the tail weighs 9 ounces, the head as much as the tail and half the body, and the body weighs as

Now, if this were so, what would be the weight of the fish?"

300.—FRESH FRUITS

SOME fresh fruit was being weighed for some domestic purpose, when it was



found that the apples, pears, and plums exactly balanced one another, as shown in the sketch. Can you say how many plums were equal in weight to one pear? The relative sizes of the fruits in the drawing must not be taken to be correct (they are purposely not so), but we must assume that every fruit is exactly equal in weight to every other of its own kind.

It is clear that three apples and one pear are equal in weight to ten plums, and that one apple and six plums weigh the same as a single pear, but how many plums alone would balance that pear?

This appears to be an excellent method

of introducing the elements of algebra to the untutored mind. When the novice starts working it out he will inevitably be adopting algebraical methods, without, perhaps, being conscious of the fact. The two weighings show nothing more than two simultaneous equations, with three unknowns.

301.—WEIGHING THE TEA

A GROCER proposed to put up 20 lbs. of China tea into 2-lb. packets, but his weights had been misplaced by somebody, and he could only find the 5-lb. and the 9-lb. weights. What is the quickest way for him to do the business? We will say at once that only nine weighings are really necessary.

302.—DELIVERING THE MILK

A MILKMAN one morning was driving to his dairy with two 10-gallon cans full of milk, when he was stopped by two countrywomen, who implored him to sell them a quart of milk each. Mrs. Green had a jug holding exactly 5 pints, and Mrs. Brown a jug holding exactly 4 pints, but the milkman had no measure whatever. How did he manage to put an exact quart into each of the jugs? It was the second quart that gave him all the difficulty. But he contrived to do it in as few as nine transactions—and by a "transaction" we mean the pouring from a can into a jug, or from one jug to another, or from a jug back to the can. How did he do it?

**CROSSING RIVER PROBLEM, AND PROBLEMS
CONCERNING GAMES AND PUZZLE GAMES**

CROSSING RIVER PROBLEM, AND PROBLEMS CONCERNING GAMES AND PUZZLE GAMES

303.—CROSSING THE RIVER

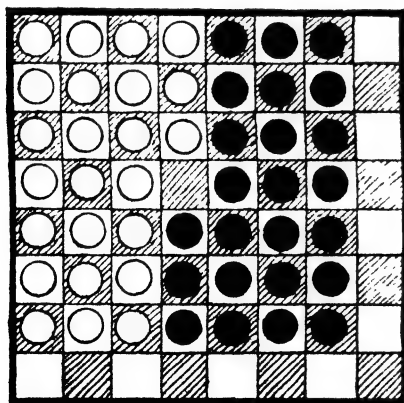
DURING the Turkish stampede in Thrace, a small detachment found itself confronted by a wide and deep river. However, they discovered a boat in which two children were rowing about. It was so small that it would only carry the two children, or one grown person. How did the officer get himself and his 357 soldiers across the river and leave the two children finally in joint possession of their boat? And how many times need the boat pass from shore to shore?

It is required to make the white men change places with the black men in the fewest possible moves. There is no diagonal play or captures. The white men can only move to the right or downwards, and the black men to the left or upwards, but they may leap over one of the opposite colour, as in draughts. It is quite easy when once you have hit on the method of solution.

305.—DOMINO FRAMES

TAKE an ordinary set of twenty-eight dominoes and return double 3, double 4,

304.—GRASSHOPPERS' QUADRILLE



double 5, and double 6 to the box as not wanted. Now, with the remainder form three square frames, in the manner shown, so that the pips in every side

shall add up alike. In the example given the sides sum to 15. If this were to stand, the sides of the two other frames must also sum to 15. But you can take any number you like, and it will be seen that it is not required to place 6 against 6, 5 against 5, and so on, as in play.

306.—A PUZZLE IN BILLIARDS

ALFRED ADDLESTONE can give Benjamin Bounce 20 points in 100, and beat him; Bounce can give Charlie Cruikshank 25 points in 100 and beat him. Now, how many points can Addlestone give Cruikshank in order to beat him in a game of 200 up? Of course we assume that the players play constantly with the same relative skill.

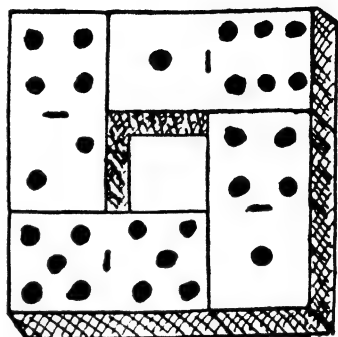
307.—SCORING AT BILLIARDS

HERE is a little question that some people would trip over in giving too hasty an answer. Just settle the question before you leave the breakfast-table. What is the highest score that you can make in two consecutive shots at billiards?

308.—DOMINO HOLLOW SQUARES

EVERY game lends itself to the pounding of interesting little puzzles. Let us, as an example, take the following poser, devised from an ordinary box of twenty-eight dominoes. It is required with these twenty-eight to form seven hollow squares, all similar to the example given, so that the pips in the four sides

of every square shall add up alike. All these seven squares need not have the same sum, and, of course, the example given need not be one of your set. The



reader will probably find it easy to form six of the squares correctly, in many ways, but the trouble generally begins when you come to make the seventh square with the four remaining dominoes.

309.—DOMINO SEQUENCES

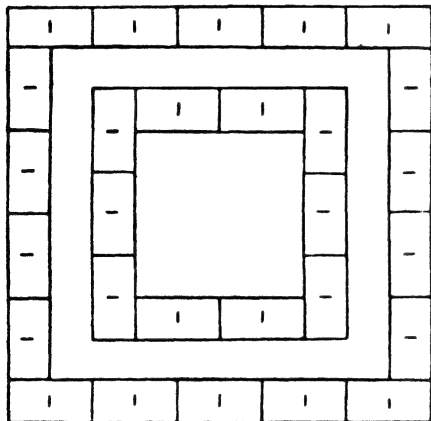
A BOY who had a complete set of dominoes, up to double 9, was trying to arrange them all in sequence, in the usual way—6 against 6, 3 against 3, blank against blank, etc. His father said to him, "You are attempting an

but if you will let me pick out four dominoes it can then be done. And those that I take shall contain the smallest total number of pips possible in the circumstances."

Now, which dominoes might the father have selected? Remember that the dominoes in common use in this country stop at double 6, but we are here using a set up to double 9.

310.—TWO DOMINO SQUARES

ARRANGE the twenty-eight dominoes as shown in the diagram to form two squares so that the pips in every one of the eight sides shall add up alike. The dominoes being on the table one day recently, we set ourselves the above task, and found



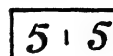
it very interesting. The constant addition must, of course, be within limits to make the puzzle possible, and it will be found interesting to find these limits. Of course, the dominoes need not be laid according to the rule, 6 against 6, blank against blank, and so on.

311.—DOMINO MULTIPLICATION

WE have received the following entertaining puzzle from W. D. W., of Philadelphia, Pa. :

Four dominoes may be so placed as to form a simple multiplication sum if we regard the pips as figures. The example here shown will make every-

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thing perfectly clear. Now, the puzzle is, using all the twenty-eight dominoes to arrange them so as to form seven such little sums in multiplication. It will be found comparatively easy to construct six such groups, while the four dominoes left over are impossible of arrangement. But it can be done, and the quest will be found amusing. No blank may be placed at the left end of the multiplicand or product.

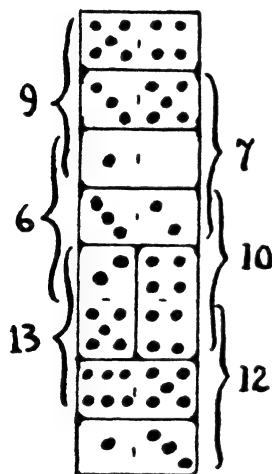
312.—DOMINO RECTANGLE

HERE is a new domino puzzle that I hope will be found entertaining. Arrange the twenty-eight dominoes exactly as shown in the illustration, where the pips are omitted, so that the pips in every one of the seven columns shall

sum to 24, and the pips in every one of the eight rows to 21. The dominoes need not be 6 against 6, 4 against 4, and so on.

313.—THE DOMINO COLUMN

ARRANGE the twenty-eight dominoes in a column so that the three sets of pips, taken anywhere, shall add up alike on



the left side and on the right. Such a column has been started in the diagram. It will be seen that the top three add up to 9 on both sides, the next three add up to 7 on both sides, and so on. This is merely an example, so you can start afresh if you like.

314.—CARD SHUFFLING

THE rudimentary method of shuffling a pack of cards is to take the pack face downwards in the left hand and then

transfer them one by one to the right hand, putting the second on top of the first, the third under, the fourth above, and so on until all are transferred. If you do this with any even number of cards and keep on repeating the shuffle in the same way, the cards will in due time return to their original order. Try with 4 cards, and you will find the order is restored in three shuffles. In fact, where the number of cards is 2, 4, 8, 16, 32, 64, the number of shuffles required to get them back to the original arrangement is 2, 3, 4, 5, 6, 7 respectively. Now, how many shuffles are necessary in the case of 14 cards?

315.—ARRANGING THE DOMINOES

SOMEBODY reminded Professor Rackbrane one morning at the breakfast-table that he had promised to tell them in how many different ways the set of twenty-eight dominoes may be arranged in a straight line, in accordance with the original rule of the game, left to right and right to left, in any arrangement counting as different ways. Later on he told them that the answer was 7,959,229,931,520 different ways. He said that it was an exceedingly difficult problem. He then proposed that they should themselves find out in how many different ways the fifteen smaller dominoes (after discarding all those

a 5

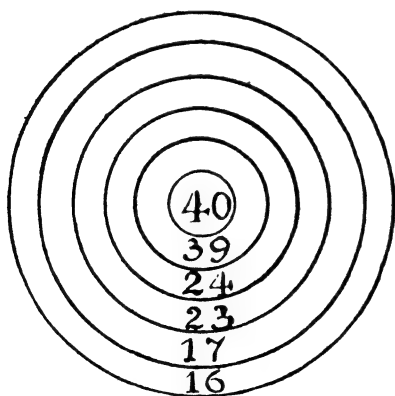
ways place 1 against 1, 6 against 6, and so on, the two directions counting different.

316.—QUEER GOLF

A CERTAIN links had nine holes, 300, 250, 200, 325, 275, 350, 225, 375, and 400 yards apart. If a man could always strike the ball in a perfectly straight line and send it exactly one of two distances, so that it would either go towards the hole, pass over it, or drop into it, what would the two distances be that would carry him in the least number of strokes round the whole course? Two very good distances are 125 and 75, which carry you round in twenty-eight strokes, but this is not the correct answer.

317.—THE ARCHERY MATCH

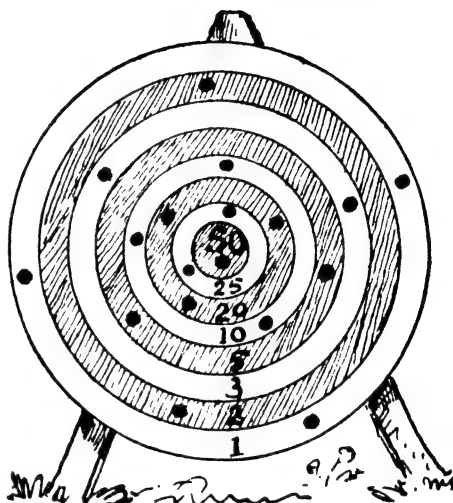
ON a target on which the scoring was 40 for the bull's-eye, and 39, 24, 23, 17, and 16 respectively for the rings from the centre outwards, as shown in the illustration, three players had a match with six arrows each. The result was:



Miss Dora Talbot, 120 points; Reggie Watson, 110 points; Mrs. Finch, 100 points. Every arrow scored, and the

bull's-eye was only once hit. Can you, from these facts, determine the exact six hits made by each

318.—TARGET PRACTICE



COLONEL CRACKHAM paid a visit one afternoon by invitation to the Slocomb-on-Sea Toxophilite Club, where he picked up the following little poser. Three men in a competition had each six shots at a target, and the result is shown in our illustration, where they all hit the target every time. The bull's-eye scores 50, the next ring 25, the next 20, the next 10, the next 5, the next 3, the next 2, and the outside ring scores only 1. It will be seen that the hits on the target are one bull's-eye, two 25's, three 20's, three 10's, three 1's, and two hits in every other ring. Now the three men tied with an equal score.

Next morning the Colonel asked his family to show the exact scoring of each man. Will it take the reader

many minutes to find the correct answer?

319.—THE TEN CARDS

PLACE any ten playing cards in a row as shown. There are two players. The first player may turn down any single card he chooses. Then the second

player can turn down any single card or two adjoining cards. And so on. The player who turns down the last card wins. Remember that the first player must

afterwards either player can turn down either a single or two adjoining cards, as he pleases. Should the first or second player win?



UNCLASSIFIED PROBLEMS

UNCLASSIFIED PROBLEMS

320.—AN AWKWARD TIME

"WHEN I told a man the other morning," said Colonel Crackham at the breakfast-table, "that I had to catch the 12.50 train, he surprised me by saying that it was a very awkward time for any train to start. I asked him to explain why. Can you guess his answer?"

321.—CRYPTIC ADDITION

CAN you prove that the following addition sum is correct?

$$\begin{array}{r} 3 \quad 0 \\ 4 \\ 0 \\ \hline \end{array}$$

322.—THE NEW GUN

WE all know that the Swiss navy is unconquerable and indestructible. The Government of Switzerland was approached by an inventor who under-

took that a new gun which he had manufactured, when once loaded, would fire fifteen shots at the rate of a shot a minute. A series of tests was made, and the gun certainly fired fifteen shots in a quarter of an hour. The Government, however, refused to buy the gun. Why?

323.—CATS AND MICE

ONE morning, at the Professor Rackbrane's party were discussing organized attempts to exterminate vermin, when the Professor suddenly said:

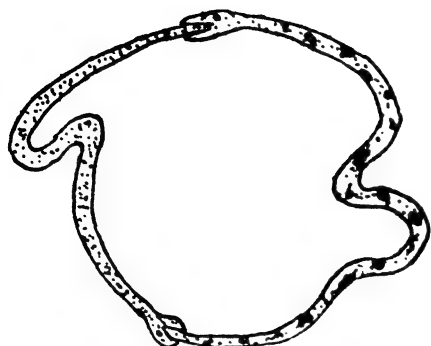
"If a number of cats killed between them 999,919 mice, and every cat killed an equal number of mice, how many cats must there have been?"

Somebody suggested that perhaps one cat killed the lot; but Rackbrane replied that he said "cats." Then somebody else suggested that perhaps 999,919 cats each killed one mouse, but he protested that he used the word "mice." He added, for their guidance, that each cat killed more mice than there were cats. What is the correct answer?

324.—THE TWO SNAKES

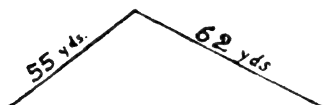
WE have been asked this question:

Suppose that two snakes start swal-



lowing one another simultaneously, each getting the tail of the other in its mouth, so that the circle formed by the snakes becomes smaller and smaller, what will eventually happen ?

325.—THE PRICE OF A GARDEN



PROFESSOR RACKBRANE informed his friends one morning that a neighbour told him that he had been offered a piece of ground for a garden. He said it was triangular in shape, with the dimensions as shown in our diagram. As the price proposed was ten shillings per square yard, what will the cost be ?

326.—STRANGE THOUGH TRUE

THERE is a district in Sussex where any sound and well-proportioned horse may travel, quite regularly, 30 miles per day, yet while its off legs are going this distance, its near legs will unavoidably

pass over nearly 31 miles. It would at first appear that the near legs of the creature must be nearly a mile ahead of the horse at the end of the journey ; but the animal does not seem to mind, for, as a matter of fact, he finishes his task quite whole and sound.

Can you explain ?

327.—TWO PARADOXES

A CHILD may ask a question that will profoundly perplex a learned philosopher, and we are often meeting with paradoxes that demand a little thought before we can explain them in simple language. The following was put to us :

"Imagine a man going to the North Pole. The points of the compass are, as every one knows—

N
W E
S

"He reaches the Pole and, having passed over it, must turn about to look North. East is now on his left-hand side, West on his right-hand side, and the points of the compass therefore—

N
E W
S

which is absurd. What is the explanation ?

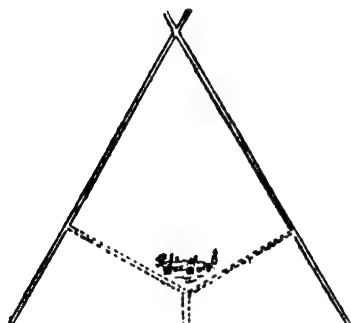
"We were standing with a front of a large mirror that reflected the whole body. 'Why is it,' asked the intelligent youngster, 'that I am turned right round in the mirror, so that right is left and left right, and yet top is not bottom and bottom top ? If it reverses

sideways, why does it not reverse lengthways? Why am I not shown standing on my head? "

you trust to the eye alone you will probably fail to get the four in correct

328.—CHOOSING A SITE

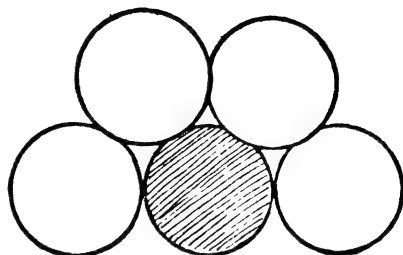
A MAN bought an estate enclosed by three straight roads forming an equilateral triangle, as shown in the illustration. Now, he wished to build a



house somewhere on the estate so that if he should have a straight carriage-drive made from the front to each of the three roads he might be put to the least expense. The diagram shows one such position. Where should he build the house?

329.—THE FOUR PENNIES

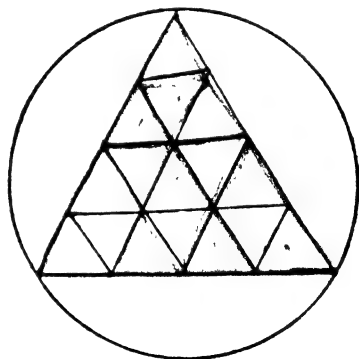
TAKE four pennies and arrange them on the table without the assistance of another coin or any other means of measurement, so that when a fifth penny is produced it may be placed in exact contact with each of the four (without moving them) in the manner shown in the illustration. The shaded circle represents the fifth penny. If



position, but it can be done with absolute exactitude. How should you proceed?

330.—THE ENCIRCLED TRIANGLES

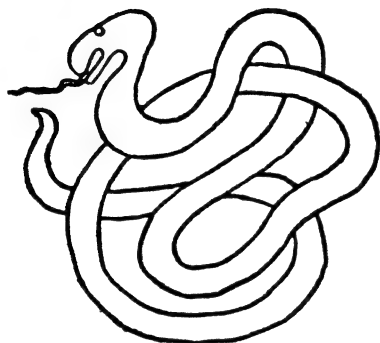
HERE is a little puzzle, fascinating by reason of its simple conditions. But the reader will require some patience and judgment to solve it. You have



merely to draw the design of circle and triangles in as few continuous strokes as possible. You may go over a line twice if you wish to do so, and begin and end wherever you like.

331.—THE SIAMESE SERPENT

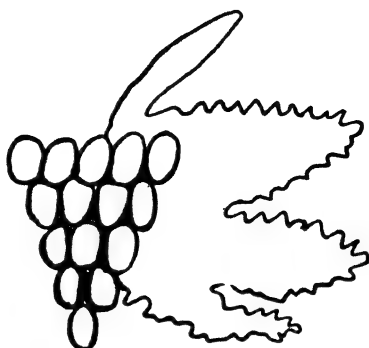
THE conditions of this puzzle are exceedingly simple. You are asked to



draw as much as possible of the serpent in one continuous line. Starting where you like and ending where you like, just see how much of the serpent you can trace without once taking your pencil off the paper or going over the same line twice. An artful person might dodge the condition of going over a line twice by claiming that he drew half the width of the line going forward and the other half going back; but he is reminded that a line has no breadth!

332.—A BUNCH OF GRAPES

HERE is a rough conventionalized sketch of a bunch of grapes. The puzzle is to make a copy of it with one continuous stroke of the pencil, never lifting the pencil from the paper, nor going over a line twice throughout. You can first try tracing it with the pencil until you get some idea of the general method.



A BUNCH OF GRAPES

333.—A HOPSCOTCH PUZZLE

WE saw some boys playing the ancient and ever popular game of hopscotch, and we wondered whether the figure that they had marked on the ground could be drawn with one continuous stroke. We found it to be possible.

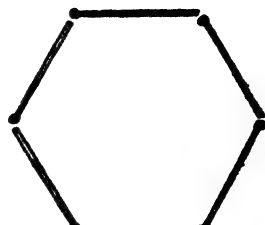


Can the reader draw the hopscotch figure in the illustration without taking his pencil off the paper or going along the same line twice? The curved line is not generally used in the game, but we give the figure just as we saw it.

334.—A LITTLE MATCH TRICK

WE pulled open a box of matches the other day, and showed some friends that there were only about twelve matches in it. When opened at that end no head was visible. The heads

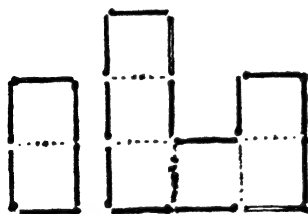
were all at the other end of the box. We told them after we had closed the box in front of them we would give it a shake, and, on reopening, they would find a match turned round with its head visible. They afterwards examined it to see that the matches were all sound. How did we do it?



No duplicated matches or loose ends allowed.

335.—THREE TIMES THE SIZE

LAY out 20 matches in the way shown in our illustration. You will see that



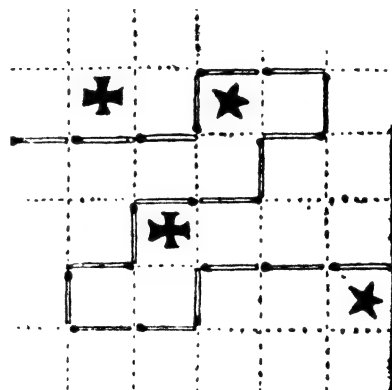
the two groups of 6 and 14 matches form two enclosures, so that one space enclosed is exactly three times as large as the other.

Now transfer 1 match from the larger to the smaller group, and with the 7 and 13 enclose two spaces again, one exactly three times as large as the other. Twelve of the matches must remain unmoved from their present positions—and there must be no duplicated matches or loose ends. The dotted lines are simply to indicate the respective areas.

336.—A SIX-SIDED FIGURE

HERE are 6 matches arranged so as to form a regular hexagon. Can you take 3 more matches and so arrange the 9 as to show another regular six-sided figure?

337.—TWENTY-SIX MATCHES

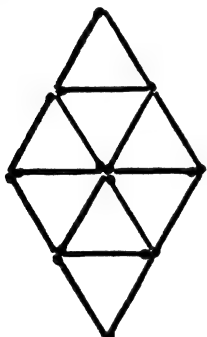


MAKE a rough square diagram, like the one shown, where the side of every little square is the length of a match, and put the stars and crosses in their given positions. It is required to place 26 matches along the lines so as to enclose two parts of exactly the same size and shape, one part containing two stars, and the other two crosses. In the example given, part is correctly of the same size and shape, and each part contains either two stars or two crosses; but, unfortunately, only 20 matches have been used. So it is not a solution. Can you do it with 26 matches?

338.—THE THREE MATCHES

CAN you place 3 matches on the table, and support the matchbox on them, without allowing the heads of the matches to touch the table, to touch one another, or to touch the box?

339.—EQUILATERAL TRIANGLES



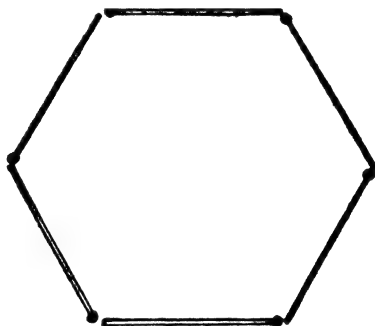
HERE is a little puzzle for juvenile readers:

Place 16 matches, as shown, to form eight equilateral triangles. Now take away 4 matches so as to leave only four equilateral triangles. No superfluous matches or loose ends to be left.

340.—SQUARES WITH MATCHES

ARRANGE 12 matches on the table, as shown in the illustration. Now it is required to remove 6 of these matches and replace them so as to form five squares. Of course 6 matches must remain unmoved, and there must be no duplicated matches or loose ends.

341.—HEXAGON TO DIAMONDS



HERE is a match puzzle for juvenile readers. With 6 matches form a hexagon, as here shown. Now, by moving only 2 matches and adding 1 more, can you form two diamonds?

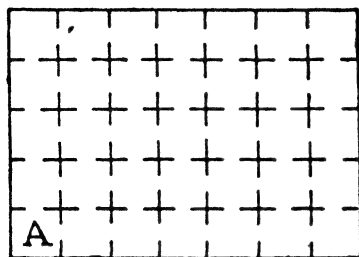
342.—A WILY PUZZLE

AN unscrupulous advertiser offered a hundred dollars for a correct solution to this puzzle:

"A life prisoner appealed to the king for pardon. Not being ready to favour the appeal, the king proposed a pardon on condition that the prisoner should start from cell A and go in and out of each cell in the prison, coming back to the cell A without going into any cell twice."

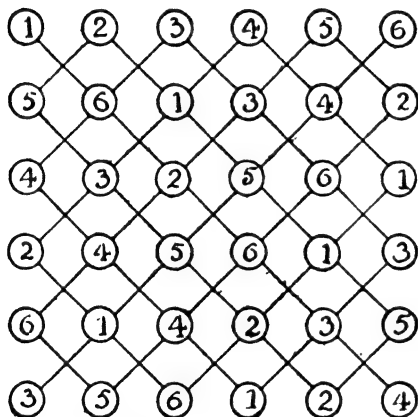
Either the advertiser had no answer,

UNCLASSIFIED PROBLEMS



and knew he had none, or he was prepared to fall back on some trick or quibble. What is the best answer the reader can devise that may be held to comply with the advertiser's conditions as given ?

343.—TOM TIDDLER'S GROUND

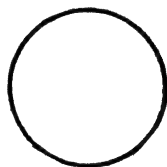


THE Crackham family were comfortably accommodated at the "Blue Boar" at Puddlebury. Here they had the luck to come upon another guest who was clearly engaged in solving some sort of puzzle. The Colonel contrived a conversation with him, and learned that the puzzle was called "Tom Tiddler's Ground."

"You know," said the stranger, "the words, 'I am on Tom Tiddler's ground picking up gold and silver.' Here we have a piece of land marked off with 36 circular plots, on each of which is deposited a bag containing as many sovereigns as the figures indicate in the diagram. I am allowed to pick up as many bags of gold as I like, provided I do not take two lying on the same line. What is the greatest amount of money I can secure ?"

344.—COIN AND HOLE

WE have before us a specimen of every current British coin from a farthing up to a sovereign. And we have a sheet of paper with a circular hole cut in it of exactly the size of the circle shown. What is the largest coin I can pass through that hole without tearing the paper ?



345.—THE EGG CABINET

A CORRESPONDENT (T. S.) informs us that a man has a cabinet for holding birds' eggs. There are twelve drawers, and all—except the first drawer, which only holds the catalogue—are divided into cells by intersecting wooden strips, each running the entire width or length of a drawer. The number of cells in any drawer is greater than that of the drawer above. The bottom drawer, No. 12, has twelve times as many cells as strips, No. 11 has eleven times as

many cells as strips, and so on. Can you show how the drawers were divided—how many cells and strips in each drawer? Give the smallest possible number in each case.

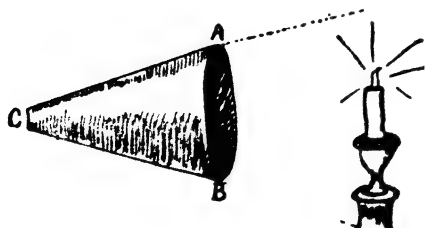
346.—A LEAP YEAR PUZZLE

THE month of February in 1928 contained five Wednesdays. There is, of course, nothing remarkable in this fact, but it will be found interesting to discover when was the last year and when will be the next year that had, and that will have, five Wednesdays in February.

347.—THE IRON CHAIN

Two pieces of iron chain were picked up on the battlefield. What purpose they had originally served is not certain, and does not immediately concern us. They were formed of circular links (all of the same size) out of metal half an inch thick. One piece of chain was exactly 3 ft. long, and the other 22 in. in length. Now, as one piece contained six links more than the other, how many links were there in each piece of chain?

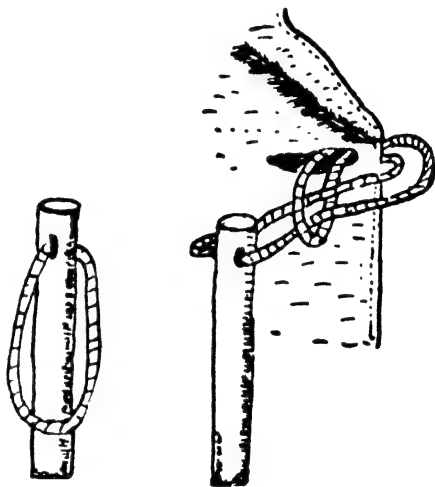
348.—BLOWING OUT THE CANDLE



CANDLES were lighted on Colonel Crackham's breakfast-table one foggy morn-

ing. When the fog lifted, the Colonel rolled a sheet of paper into the form of a hollow cone, like a megaphone. He then challenged his young friends to use it in blowing out the candles. They failed, until he showed them the trick. Of course, you blow through the small end.

349.—RELEASING THE STICK



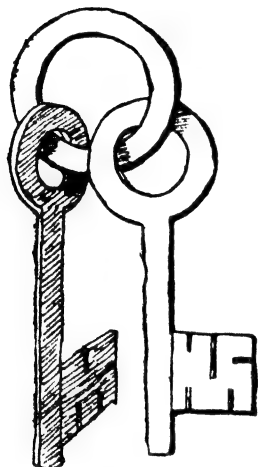
HERE is a puzzle that will often a good deal of bewilderment amongst your friends, though it is not so ally known as it deserves to be. I think it was invented by the late Sam Loyd, the American chess and puzzle genius. At any rate, it was he who first showed it to us more than a quarter of a century ago.

It is simply a loop of string passed through one end of a stick as here shown, but not long enough to pass round the other end. The puzzle is to suspend it in the manner shown from the top hole

of a man's coat, and then get it free again.

350.—THE KEYS AND RING

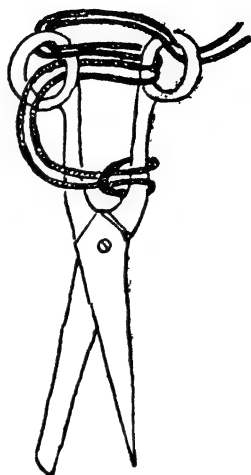
COLONEL CRACKHAM the other day produced a ring and two keys, as here shown, cut out of a solid piece of card-



board, without a break or join anywhere. Perhaps it will puzzle the reader more than it puzzled George, who promptly cut them out.

351.—THE ENTANGLED SCISSORS

HERE is an old puzzle that many readers, who have forgotten how to put on the string, will be glad to see again. If you start on the loop at the bottom, the string can readily be got into position. The puzzle is, of course, to let some one hold the two ends of the string until you disengage the scissors. A good length of string should be used to give you free play. We would also advise the use of



a large pair of scissors and thick cord that will slide easily.

352.—LOCATING THE COINS

"Do you know this?" said Dora to her brother. "Just put a shilling in one of your pockets and a penny in the pocket on the opposite side. Now the shilling represents 12 and the penny 1. I want you to triple the coin in your right pocket, and double that which is in your left pocket. Add these two products together and tell me whether the result is odd or even."

He said the result was even, and she immediately told him that the shilling was in the right pocket and the penny in the left one. Every time he tried it she told him correctly how the were located. How did she do it?

353.—THE THREE SUGAR BASINS

THE three basins each contain the same number of lumps of sugar, and the cups



are empty. If we transfer to each cup one-eighteenth of the number of lumps that each basin contains, we then find that each basin holds 12 more lumps than each of the cups. How many lumps are there in each basin before they are removed?

354.—THE WHEELS OF THE CAR

"You see, sir," said the motor-car salesman, "at present the fore wheel of the car I am selling you makes four revolutions more than the hind wheel in going 120 yards; but if you have the circumference of each wheel reduced by 3 ft., it would make as many as six revolutions more than the hind wheel in the same distance."

Why the buyer wished that the difference in the number of revolutions between the two wheels should not be increased does not concern us. The puzzle is to discover the circumference

of each wheel in the first case. It is quite easy.

355.—THE SEVEN CHILDREN

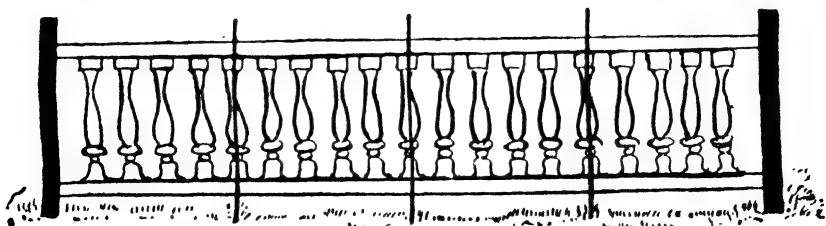
FOUR boys and three girls are seated in a row at random. What are the chances that the two children at the ends of the row will be girls?

356.—A RAIL PROBLEM

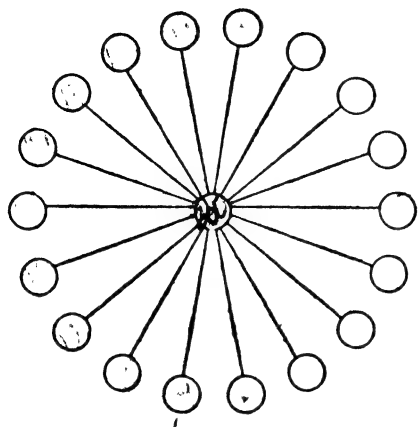
THERE is a garden railing similar to our design. In each division between two uprights there is an equal number of ornamental rails, and a rail is divided in halves and a portion stuck on each side of every upright, except that the uprights at the ends have not been given half rails. Idly counting the rails from one end to the other, we found that there were 1,223 rails, counting two halves as one rail. We also noticed that the number of those divisions was five more than twice the number of *whole* rails in a division. How many rails were there in each division?

357.—THE WHEEL PUZZLE

HERE is a little puzzle that Dora Crackham gave at Christmas for some of her young friends.



A RAIL PROBLEM



Place the numbers 1 to 19 in the 19 circles, so that wherever there are three in a straight line they shall add up to 30. It is, of course, very easy.

358.—SIMPLE ADDITION

CAN you show that four added to six will make eleven?

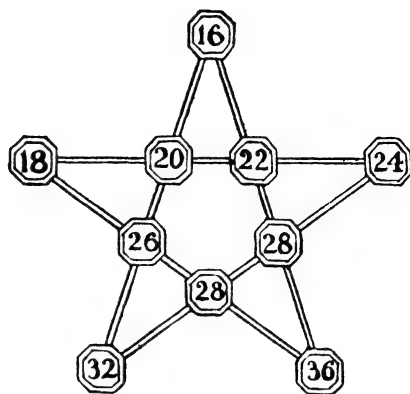
359.—QUEER ARITHMETIC

CAN you take away seven-tenths from five so that exactly four remains?

360.—FORT GARRISONS

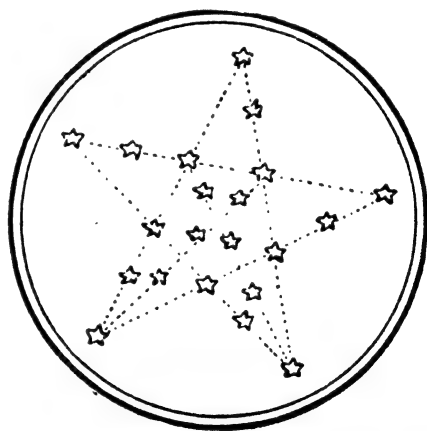
HERE we have a system of fortifications. It will be seen that there are ten forts, connected by lines of outworks, and the numbers represent the strength of the small garrisons. The General wants to dispose these garrisons afresh so that there shall be 100 men in every one of the five lines of four forts. Can you show how it can be done? The garrisons must be moved bodily—that is

(8,646)



to say, you are not allowed to break them up into other numbers. It is quite an entertaining little puzzle with counters, and not very difficult.

361.—CONSTELLATION PUZZLE



THE arrangement of stars in the illustration is known as "The British Constellation." It is not given in any star maps or books, and it is very difficult to find on the clearest night for the simple reason that it is not visible. The 21 stars form seven lines with 5 stars in

every line. Can you rearrange these 21 stars so that they form eleven straight lines with 5 stars in every line? There are many solutions. Try to find a symmetrical one.

362.—INTELLIGENCE TESTS

NOWADAYS the schools are all out to give their children "Intelligence Tests," and in *The New Examiner*, by Dr. Ballard, there is a fine collection. I have included one here which, although not new, is really worthy of honourable mention.

An English officer, after a gruesome experience during the Boxer rebellion in China some years ago, fell asleep in church during the sermon. He was dreaming that the executioner was approaching him to cut off his head, and just as the sword was descending on the officer's unhappy neck his wife lightly touched her husband on the back of his neck with her fan to awaken him. The shock was too great, and the officer fell forward dead. Now, there is something wrong with this. What is it?

Another good question on similar lines for the scientific boy would be:

If we sell apples by the cubic inch, how can we really find the exact number of cubic inches in, say, a dozen dozen apples?

363.—AT THE MOUNTAIN TOP

"WHEN I was in Italy I was taken to the top of a mountain and shown that a mug would hold less liquor at the top of this mountain than in the valley beneath. Can you tell me," asked Professor Rackbrane, at the breakfast-table, "what mountain this might be that has so strange a property?"

364.—CUPID'S ARITHMETIC

DORA CRACKHAM one morning produced a slip of paper bearing the jumble of figures shown in our illustration. She said that a young mathematician had this poser presented to him by his betrothed when she was in a playful mood.

"What am I to do with it?" asked George.

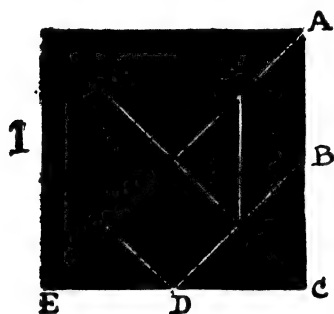
"Just interpret its meaning," she replied. "If it is properly regarded it should not be difficult to decipher."

365.—TANGRAMS

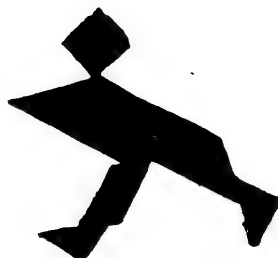
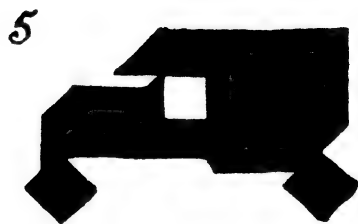
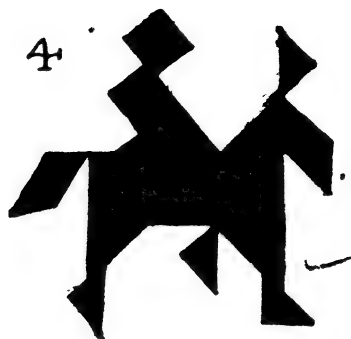
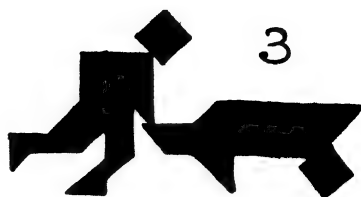
THOSE readers who were interested in the article on "Tangrams" in *Amusements in Mathematics*, may be glad to have a further collection of examples of the strikingly realistic figures and designs that can be produced by combining these curious shaped pieces. In diagram 1 the square is shown cut into the seven

15122 1116 96016621

pieces. If you mark the point B, midway between A and C, on one side of a square of any size, and D, midway between C and E, on an adjoining side, the direction of the cuts is obvious. In the examples given below, two complete sets of seven pieces have been combined.



Batsman.

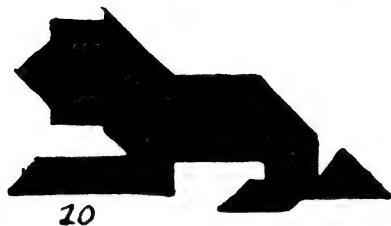
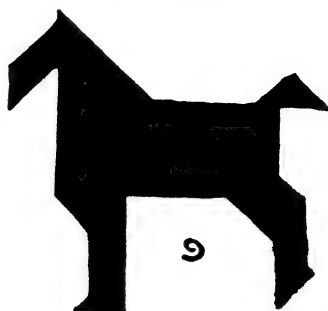
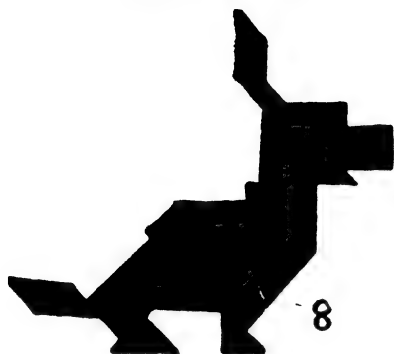
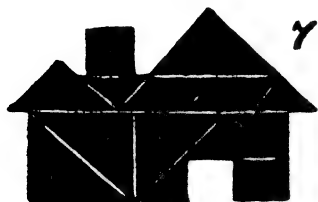


Bowler.

Diagram 2 represents a man riding a bicycle; 3, a man pushing a wheel-

7, a house; 8, a dog; 9, a horse; 10, the British lion.

As will be seen, the possibility with



barrow; 4, a boy riding a donkey; 5, a motor-car; 6, two cricketers in motion;

these two sets combined is infinite, and many interesting subjects may be produced very successfully.

SOLUTIONS

SOLUTIONS

1.—THE MONEY BAG

TWENTY-TWO crowns and thirty-three shillings.

2.—A LEGACY PUZZLE

THE legacy to the first son was £55, to the second son £275, to the third son £385, and to the hospital £605, making £1,320 in all.

3.—BUYING TOYS

GEORGE must have bought 1 engine, 1 ball, 5 dolls, and 14 trumpets—21 articles costing 2s. William must have bought 2 engines, 2 balls, 1 doll, and 16 trumpets—also 21 articles for 2s.

4.—PUZZLING LEGACIES

THE answer is £1,464—a little less than £1,500. The legacies, in order, were £1,296, £72, £38, £34, and £18. The lawyer's fee would be £6.

5.—DIVIDING THE LEGACY

THE two legacies were £24 and £76, for if $\frac{1}{8}$ (one-third of 24) be taken from 19 (one-fourth of 76) the remainder will be 11.

6.—A NEW PARTNER

WE must take it for granted that the sum Rogers paid, £2,500, was one-third of the value of the business, which was consequently worth £7,500 before he entered. Smugg's interest in the business had therefore been £4,500 (one and a half times as much as Williamson), and Williamson's £3,000. As each is now to have an equal interest, Smugg will receive £2,000 of Rogers's contribution, and Williamson £500.

7.—SQUARING POCKET-MONEY

THE coins were a half-crown, a shilling, a sixpence, and a penny (49 pence). He spent the penny, and the number of shillings was then 4. He then spent the shilling, and the number of pence was 36. And as the half-crown equals 60 halfpence, and the sixpence equals 24 farthings, their difference is 36—again a square.

8.—EQUAL VALUES

THE two ladies had 10s., 1s., and 6d. in one purse, and 5s., 4s., and 2s. 6d. in the other—that is, 11s. 6d. each. They each spent 4s., and returned with 5s., 2s., and 6d. in one purse, and 4s., 2s. 6d.,

and 1s. in the other. They started with 11s. 6d. each and ended with 7s. 6d. each.

9.—POCKET MONEY

WHEN he left home Tomkins must have had 3s. 6d. in his pocket.

10.—MENTAL ARITHMETIC

REDUCE the $7\frac{1}{2}d.$ to farthings and then double, which gives 31 and 62. Then all you have to do is to add 62 shillings to 31 pence, and you get at once £3, 4s. 7d. I should thus have lost 5d. by buying the 100, and it would become a simple question of whether the box was worth 5d. to me.

11.—DISTRIBUTION

THE smallest number originally held will be (in pence) one more than the number of persons. The others can be obtained by continually doubling and deducting one. So we get their holdings as 10, 19, 37, 73, 145, 289, 577, 1,153, and 2,305. Let the largest holder start the payment and work backwards, when the number of pence in the end held by each person will be 2^9 , or 512—that is, £2, 2s. 8d.

12.—REDUCTIONS IN PRICE

It is evident that the salesman's rule was to take off five-eighths of the price at every reduction. Therefore, to be consistent, the motor-car should be offered at £78, 2s. 6d., after the next reduction.

13.—THE THREE HOSPITALS

THE total value of the contributions was 213 shillings, therefore each hospital must receive 71 shillings. Give one 50s., 10s., 5s., 3s., 2s., and 1s.; give another 25s., 20s., 20s., 3s., 2s., and 1s.; and give the third 25s., 20s., 10s., 10s., 5s., and 1s.

14.—HORSES AND BULLOCKS

REDUCING the amounts to shillings, we have to solve the indeterminate equation $344x = 265y + 33$. This is easy enough if you know how, but we cannot go into the matter here. Thus x is 252, and y is 327, so that if he buys 252 horses for 344s. apiece, and 327 bullocks for 265s. apiece, the horses will cost him in all 33s. more than the bullocks.

15.—BUYING TURKEYS

THE man bought 75 turkeys at 16s. each, making £60. After retaining 15 he sold the remaining 60 at 18s. each, making £54, as stated. He thus made a profit of 2s. each on the 60 birds he resold.

16.—THE THRIFTY GROCER

HE must have had 168 each of 20s. notes, of 10s. notes, and of 5s. pieces, making a total of 5,880s., or £294. In each of the six bags there would be 28 of each kind; in each of the seven bags 24 of each kind; and in each of the eight bags, 21 of each kind.

17.—THE MISSING PENNY

THE explanation is simply this. The two ways of selling are only identical when the number of apples sold at three a penny and two a penny is in the proportion of three to two.

Thus, if the first woman had handed over 36 apples, and the second woman 24, they would have fetched 2s., whether sold separately or at five for 2d. But if they each held the same number of apples there would be a loss when sold together of 1d. in every 60 apples. So if they had 60 each there would be a loss of 2d. If there were 180 apples (90 each) they would lose 3d., and so on.

The missing penny in the case of 60 arises from the fact that the three a penny woman gains 2d., and the two a penny woman loses 3d.

Perhaps the fairest practical division of the 2s. would be that the first woman receives 9½d. and the second woman 1s. 2½d., so that each loses ½d. on the transaction.

18.—THE RED DEATH LEAGUE

THE total amount of subscriptions, reduced to farthings, is 300,737, which is the product of 311 and 967, each of which is a prime. As we know that the R.D.L. had fewer than 500 members, it follows that there were 311, and they each paid as a subscription 967 farthings, or £1, os. 1¾d. This is the only possible answer.

19.—A POULTRY POSER

THE price of a chicken was 2s., for a duck 4s., and for a goose 5s.
(3,846)

20.—BOYS AND GIRLS

EVERY boy at the start possessed 3d., and he gave ½d. to every girl. Every girl held 9d., of which she gave ¾d. to every boy. Then every child would have 4½d.

21.—THE COST OF A SUIT

THE cost of Melville's suit was £6, 15s., the coat costing £3, 7s. 6d., the trousers £2, 5s., and the vest £1, 2s. 6d.

22.—THE WAR HORSE

THE £30 represented half the price the farmer paid for the horse quarters the cost of his keep. So one-quarter of the keep would be one-third of £23, 10s., or £7, 16s. 8d., and the total loss £14, 6s.

23.—A DEAL IN CUCUMBERS

THE cucumbers were 8d. each. Then seventy-two at 8d. each cost 48s., and forty-eight at 8d. is 32s.

24.—THE TWO TURKEYS

THE large turkey weighed 16 lbs., and was sold at 1s. 6½d. per lb.; and the small turkey weighed 4 lbs., and was sold at 1s. 8½d. per lb.

25.—FLOORING FIGURES

THE only answer appears to |
298 ft. flooring boards at 2d. = £2, 9s. 8d.

26.—CROSS AND COINS

10:

1d

1 s.

THE illustration shows a solution. Only one coin—the farthing—is repeated, and in both directions the sum is £1, 2s. 7½d. Readers may possibly ask how many different arrangements are possible, all correctly adding up to this amount. Well, the penny must, in every solution, remain in its present position, but the seven coins in the upright may be permuted in 2,520 ways (the two farthings being regarded as indistinguishable), and the four coins in the horizontal may be permuted in 24 ways. Therefore, $2,520 \times 24 = 60,480$ —the number of different ways in which the coins may be arranged. But we can exchange the three coins 2s., 6d., and ½d. in the horizontal with the 2s. 6d., ¼d., and ½d. in the upright. This new arrangement will give $5,040 \times 12 = 60,480$ solutions also, so the total number of ways is twice 60,480, or 120,960.

27.—BUYING TOBACCO

THE cigarettes must have cost 2s. 5d., and the tobacco 5s. 2d. The change from a 10s. note would thus be also 2s. 5d.

28.—THE FARTHINGS PUZZLE

THERE is only one sum of money that fulfils the conditions. It is £12, 12s. 8d., which reduces to 12,128 farthings.

29.—THE SHOPKEEPERS PUZZLE

THE only word (not a jumble of letters) that will fit the conditions is REGULATION. Used in the way explained, the actual sum was :

36,407

134,928

30.—SUBSCRIPTIONS

THE man subscribed £13, 10s. Add this to the £60 from the other six men, and we get £73, 10s. The average is therefore a seventh of this—£10, 10s. So that the seventh man subscribed £3 more than this average, as stated.

31.—A QUEER SETTLING UP

RICHARD had 4s., and John had 2s. 6d.

32.—APPLE TRANSACTIONS

THE apples cost 8s. per 100.

33.—PROSPEROUS BUSINESS

HE possessed £22,781, 5s.

34.—THE BANKER AND THE NOTE

SINCE the identical forged note can be traced through all the transactions, these are all invalid. Therefore everybody stands in relation to his debtor just where he was before the banker picked up the note, except that the butcher owes, in addition, five pounds to the farmer for the calf received.

35.—THE REAPERS' PUZZLE

As Jake could alone do the job in nine days, he will do $\frac{1}{9}$ in five days, and earn 50s. Ben should have earned 40s., but he had to relinquish 3s. 9d. to Bill, so Ben is worth 36s. 3d. for five days' work. These three amounts account for the 90s. Now Ben could have earned the full 90s. in $12\frac{1}{2}$ days, and Bill, who was worth 22½d. per day, would take forty-eight days to earn the full 90s. We thus find that Ben and Bill together would have done the whole job in 48 days.

36.—THE FLAGONS OF WINE

ASSUME all empties are returned. Then 13 flagons of wine, plus 1 flagon and 1 cap, will cost $12 \times 4s. 6d.$, less 3d. = 53s. 9d., plus 12 caps. These 13 flagons of wine (without the capsule system) would cost 13 times 4s. 6d. = 58s. 6d. Therefore the difference, 4s. 9d., represents the 12 caps, each of which is worth 4s. 9d. ÷ 12 = 3d. Now, for 12 more flagons of wine plus 1 flagon and 1 cap, I pay $11 \times 4s. 6d.$, less 3d. = 49s. 3d., the cost of which 12 (without caps) would be 54s., showing again the difference of 4s. 9d., or 4½d. a

cap. And the cost of the caps will be the same for every dozen flagons of wine that we secure. The error stated consists partly in overlooking that 3d.—the value of the free flagon when returned.

37.—A WAGES PARADOX

SUPPOSE a man has been receiving a weekly wage of £3, 10s. This is then increased to £200 per annum, to be paid monthly by cheque. It is decided for the first month of the new arrangement to continue paying week by week, and there are five weekly pay days in this first month. As the total paid in this month must be £16, 13s. 4d., it follows that the weekly sum paid on each of the five pay days will be £3, 6s. 8d. only, or less by 3s. 4d. than under the old arrangement! He thus receives less per week, though earning more per annum!

38.—THE PICNIC

MARY was the wife of William Smith; Anne the wife of Patrick Dolan; Jane the wife of John MacGregor; and Elizabeth the wife of Lloyd Jones.

39.—SURPRISING

IF there were two men, each of whom marries the mother of the other, and there is a son of each marriage, then each of such sons will at once be uncle and nephew to the other. This is the simplest answer.

40.—AN EPITAPH (A.D. 1538)

IF two widows had each a son, and each widow married the son of the other and had a daughter by the marriage, all the relationships will be found to result.

41.—ANCIENT PROBLEM

DEMOCHARES must be just sixty years of age.

42.—FAMILY AGES

THE father and mother were both of the same age, thirty-six years, and the three children were triplets of six years of age. Thus the sum of all their ages is ninety years, and all the other conditions are correctly fulfilled.

43.—MIKE'S AGE

MIKE'S present age is $10\frac{1}{2}$ years, Pat's is $29\frac{1}{2}$, and Biddy's is $24\frac{3}{4}$ years. When the sty was built ($7\frac{3}{4}$ years ago), Mike was $3\frac{1}{2}$, Pat was $22\frac{1}{4}$, and Biddy was $17\frac{1}{4}$. In $11\frac{1}{4}$ years Mike will be $22\frac{1}{4}$ (as old as Pat was when he built the sty), Pat will be $41\frac{1}{4}$, and Biddy will be $36\frac{1}{4}$, making 100 years together.

44.—THEIR AGES

THIRTY years and twelve years respectively.

45.—BROTHER AND SISTER

THE boy's age was ten years, and his sister's four years.

46.—A SQUARE FAMILY

THE ages of the nine children were respectively 2, 5, 8, 11, 14, 17, 20, 23, 26, and the age of the father was 48.

47.—THE QUARRELSOME CHILDREN

EACH parent had three children when they married, and six were born afterwards.

48.—ROBINSON'S AGE

ROBINSON'S age must have been 32, his brother's 34, his sister's 38, and his mother's 52.

49.—THE ENGINE-DRIVER'S NAME

IT is clear that the guard cannot be Smith, for Mr. Smith is certainly the driver's nearest neighbour, and his income is, therefore, exactly divisible by 3, which £1,000, 10s. 2d. is not. Also the stoker cannot be Smith, because Smith beats him at billiards. Therefore the driver must be Smith, and as we are concerned with him only, it is immaterial whether the guard is Jones and the stoker Robinson, or vice versa.

50.—SHARING THE APPLES

NED SMITH and his sister Jane took 3 and 3 respectively, Tom and Kate Brown took 8 and 4 respectively, Bill and Anne Jones took 3 and 1 respectively, and Jack and Mary Robinson took 8 and 2 respectively. This accounts for the 32 apples.

51.—BUYING RIBBON

MARY's mother was Mrs. Jones. Now :

Daughters.

Hilda	bought	4	yds. for	16	farthings.
Gladys	"	6	" "	36	"
Nora	"	9	" "	81	"
Mary	"	10	" "	100	"

Mothers.

Mrs. Smith	8	yds. for	64	farthings.
Mrs. Brown	12	" "	144	"
Mrs. White	18	" "	324	"
Mrs. Jones	20	" "	400	"

52.—IN THE YEAR 1900

THE man was born in 1856 and died in 1920, aged 64 years. Let x = age at death. Then $29x$ = date of birth. The date of birth + age = date of death, so that $29x + x = 30x$, or date of death. Now, from the question he was clearly alive in 1900, and is dead now in 1930. So death occurred during or between those dates, and as the date is $30x$, it is divisible by 30. The date can only be 1920, which, divided by 30, gives 64. So in 1900 he was 44 years of age.

53.—FINDING A BIRTHDAY

THE man must have been born at midday on February 19, 1873, and at midday on November 11, 1928, he will have lived $10,176\frac{1}{2}$ days in each century. Of course, the century ended at midnight on December 31, 1900, which was not a leap year, and his age will be 55 years and nearly 9 months.

54.—THE BIRTH OF BOADICEA

THERE were 129 years between the birth of Cleopatra and the death of Boadicea; but, as their united ages amounted to 100 years only, there must have been 29 years when neither existed—that is, between the death of Cleopatra and the birth of Boadicea. Therefore Boadicea must have been born 29 years after the death of Cleopatra in 30 B.C., which would be in the year 1 B.C.

55.—ELIZA'S SURNAME

OBVIOUSLY we have to take into consideration the three penny pencils, and the puzzle cannot be solved without doing so. Then every man spends (on shares) 251*d.* more than his wife. Eliza's surname must have been Robinson, and the transactions as follows :

Brown, 21; Mrs. Brown (Mary), 71.

Smith, 49; Mrs. Smith (Jane), 169.

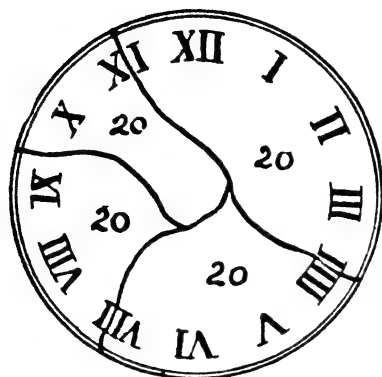
Robinson, 289; Mrs. Robinson (Eliza), 1,001.

56.—THE AMBIGUOUS CLOCK

THE first time would be in $57\frac{5}{13}$ minutes past twelve, which might also (the hands being similar) indicate 1 hour $0\frac{90}{13}$ minutes.

57.—THE BROKEN CLOCK FACE

IF the clock face be broken or cracked in the manner shown in our illustration, the numerals on each of the four parts will sum to 20. The cunning reader will at once have seen that, as three X's (in IX., X., and XI.) are adjacent, two



of these must be alone contained in one piece. Therefore there are only two possible cases for trial.

58.—WHEN DID THE DANCING BEGIN ?

THE dancing must have begun at $59\frac{83}{143}$ minutes past ten, and the hands were noticed to have changed places at $54\frac{38}{143}$ minutes past eleven.

59.—MISTAKING THE HANDS

THE time must have been $5\frac{6}{11}$ minutes past two o'clock.

60.—EQUAL DISTANCES

At $23\frac{1}{3}$ minutes past three o'clock.

61.—RIGHT AND LEFT

It must be $41\frac{7}{8}$ minutes past three o'clock.

62.—AT RIGHT ANGLES

To be at right angles the minute hand must always be exactly fifteen minutes

either behind or ahead of the hour hand. Each case would happen eleven times in the twelve hours—i.e. every 1 hour $5\frac{5}{11}$ minutes. Starting from nine o'clock, the eighth addition will give the case 5 hours $43\frac{7}{11}$ minutes. In the other case, starting from three o'clock, the second addition gives 5 hours $10\frac{10}{11}$ minutes. These are the two cases between five and six, and the latter will, of course, be the sooner.

63.—WESTMINSTER CLOCK

THE times were 8 hours $23\frac{1}{4}$ minutes, and 4 hours $41\frac{3}{4}$ minutes. We are always allowed to assume that these fractional times can be indicated in these clock puzzles.

64.—THE BATH CHAIR

IF the man leaving A goes $1\frac{1}{3}$ miles at 5 miles per hour, he will take 20 minutes ; and the return journey at 4 miles per hour will take them 25 minutes. He thus overtakes the invalid at 12.35, when the latter has gone $\frac{2}{3}$ mile in 35 minutes, and his rate is $1\frac{1}{2}$ miles per hour.

65.—THE PEDESTRIAN PASSENGER

ASSUME that the train runs for an hour, and that it is itself of the absurd length of 3 miles. Then, as in the diagram, the train will have gone from B to C

= 60 miles, but the passenger will have gone from A to C, or 63 miles. On the other hand, if he walks from the front to the rear of the train, the train will have gone from B to C (again 60 miles), while the passenger will have gone from B to D = 57 miles. So that in our first case the man would be travelling over the permanent way at the rate of 63 miles per hour, and in the second case 57 miles per hour.

66.—MEETING TRAINS

As the journey takes five hours, divide the route into five equal distances. Now, when the lady leaves Wurzelton there are four trains on the way and a fifth just starting. Each of these five she will meet. Also, when she has gone one-fifth of the distance, another will start; at two-fifths, another; at three-fifths, another; at four-fifths, another; and when she arrives at Mudville a train will be just on the point of starting. If we assume, as we must, that she does not meet this one "on the way," or meet the one that arrived at Wurzelton just as she left, she will have met altogether nine trains on the journey.

67.—CARRYING BAGS

LET the boy continue to carry one bag for one mile and one-third; then hand it to the gentleman, who will carry it to the station. Also let the man carry his bag two miles and two-thirds, and then deliver it to the boy, who will carry it for the remaining distance. Then each of the three persons will have carried

one bag two miles and two-thirds—an equal division of labour.

68.—THE MOVING STAIRCASE

LET n equal number of steps in staircase, and take as unit of time the time taken by one step to disappear at bottom.

The second man takes 75 steps in $n - 75$ units of time, or (dividing by 25) 3 steps in $\frac{n - 75}{25}$ units. Therefore first

man takes 1 step in $\frac{n - 75}{25}$ units. But first man also takes 50 steps in $n - 50$ units of time, or 1 step in $\frac{n - 50}{50}$ units of time. Therefore $\frac{n - 50}{50} = \frac{n - 75}{25}$ and $n = 100$ —the required answer.

69.—THE FOUR CYCLISTS

A, B, C, D could ride one mile in $\frac{1}{8}$ th, $\frac{1}{7}$ th, $\frac{1}{6}$ th, and $\frac{1}{5}$ th of an hour respectively. They could, therefore, ride once round in $\frac{1}{8}$ th, $\frac{1}{7}$ th, $\frac{1}{6}$ th, and $\frac{1}{5}$ th of an hour, and consequently in $\frac{1}{3}$ th of an hour (that is, $6\frac{2}{3}$ minutes) they would meet for the first time. Four times in $6\frac{2}{3}$ minutes is $26\frac{2}{3}$ minutes. So that they would complete their task in 26 minutes 40 seconds past noon.

70.—THE DONKEY-CART

THE journey took $10\frac{1}{4}$ hours. Atkins walked $52\frac{1}{4}$ miles at the end of his journey, Brown walked $13\frac{3}{4}$ at the beginning, and Cranby's donkey went altogether $80\frac{1}{4}$ miles. I hope the ass had a good rest after performing the feat.

71.—THE THREE MOTOR-CARS

B would pass C in $6\frac{1}{2}$ minutes.

72.—THE FLY AND THE MOTOR-CARS

(1) THE fly meets car B in 1 hour 48 minutes. (2) There is no necessity here to work out the distance that the fly travels—a difficult series for the novice. We simply find that the cars meet in exactly 2 hours. The fly really travels in miles :

$$\frac{270}{1} + \frac{270}{10} + \frac{270}{100} + \frac{270}{1,000} \dots \text{to infinity,}$$

and the sum of this geometrical decreasing series is exactly 300 miles.

73.—THE TUBE STAIRS

THE least common multiple of 2, 3, 4, 5, 6, 7 is 420. Deduct 1, and 419 is a possible number for the stairs, and every addition of 420 will also work. So the number of risers might be either 419, 839, 1,259, 1,679, etc., only we were told that there were fewer than 1,000, and that there was another stairway on the line with fewer steps that had the same peculiarity. Therefore there must have been 839 risers in the Curling Street stairway.

74.—THE OMNIBUS RIDE

THEY can ride three times as fast as they can walk, therefore three-quarters of their time must have been spent in walking, and only a quarter in riding. Therefore they rode for two hours, going

18 miles, and walked back in six hours, thus exactly filling their eight hours.

75.—A QUESTION OF TRANSPORT

THE car should take four men twelve miles, and drop them eight miles from their destination; then return eight miles and pick up four men from the eight who have walked to that point; then proceed twelve miles, and drop the second four four miles from destination; then return eight miles and pick up the last four, who will be eight miles from the starting-point; then drive these twelve miles to their destination, where all will arrive at the same time. The car has thus gone fifty-two miles, which would take two hours and three-fifths. The time of arrival was, therefore, 2.36 p.m.

76.—HOW FAR WAS IT?

THE distance must have been 300 miles.

77.—OUT AND HOME

THE distance must be $13\frac{1}{2}$ miles, so that he walked into the town in $2\frac{1}{2}$ hours and returned in $4\frac{1}{2}$ hours, making 7 hours, as stated.

78.—THE MEETING CARS

THE distance from London to Bugleminster must be 72 miles.

79.—A CYCLE RACE

THEY will come together 12 minutes from the start.

80.—A LITTLE TRAIN PUZZLE

THERE is no necessity for any algebraical working in the solution of this problem, nor need we know the distance between the two stations. Wherever they meet, just send the two trains back for an hour's journey at their respective rates. One will obviously go 60 miles and the other 40 miles, so they were 100 miles (60 added to 40) apart an hour before they met!

81.—AN IRISH JAUNT

AFTER travelling twenty minutes Pat said we had gone just half as far as the remaining distance to Pigtown, so it is clear that from Boghooley to Pigtown took one hour.

Five miles beyond Pigtown we were at a point half as far from Ballyfoyne as from Pigtown. Then we reached Ballyfoyne in an hour, from which we know that we took three hours from Pigtown to Ballyfoyne, and therefore the time of the complete journey was four hours. Now we find that the five-mile run took two hours, so in the four hours we must have done ten miles, which is the correct distance from Boghooley to Ballyfoyne.

82.—A WALKING PROBLEM

THE second man, on seeing his friend

backwards 200 yards. It was an eccentric thing to do, but he did it, and it is the only answer to the puzzle. They could thus have their faces towards each other and be going in a direct line.

(3,646)

83.—THREE DIFFERENT DIGITS

THE numbers are 162, 243, 324, 392, 405, 512, 605, 648, 810, and 972.

These, we think, are all the cases that exist.

84.—FIND THE CUBE

FIND the largest cube contained in 592,788, and it will be the cube of 84, with 84 also as the remainder.

85.—SQUARE AND TRIANGULARS

TO find numbers that are both square and triangular, one has to solve the Pellian equation, 8 times a square plus 1 equals another square. The successive numbers for the first square are 1, 6, 35, etc., and for the relative second squares 3, 17, 99, etc. Our answer is therefore 1,225 (35^2), which is both a square and a triangular number.

86.—DIGITS AND CUBES

THERE are three solutions. They are 56,169 (the square of 237), where $56 + 69 = 125$ (the cube of 5); 63,001 (the square of 251), where $63 + 01 = 64$ (the cube of 4); 23,104 (the square of 152), where $23 + 04 = 27$ (the cube of 3).

87.—REVERSING THE DIGITS

989,010,989 multiplied by 123,456,789 produces 122,100,120,987,654,321, where the last nine digits are in the reverse order.

88.—DIGITAL PROGRESSION

THE Professor's answer was :

297	564	831
291	564	837
237	564	891
231	564	897

where the common differences are respectively 267, 273, 327, and 333. He pointed out that the three digits in the central number may be arranged in any of the six possible ways, and a solution may be found.

89.—FORMING WHOLE NUMBERS

IF you multiply 6,666 by the sum of the four given digits you will get the correct answer. As 1, 2, 3, 4 sum to 10, then 6,666 multiplied by 10 gives us 66,660 as our answer. Taking all possible selections of four different digits, the answer is 16,798,320, or $6,666 \times 2,520$.

90.—SUMMING THE DIGITS

THERE are several ways of attacking this puzzle, and the answer is 201,599,999,798,400. The sum of the digits is 45 and

$$45 \times 8 = 90 \times 4 \frac{1}{2} = 90 \times 20,160 = 1,814,400$$

Now write down—

18144
18144
18144
18144

to nine places, add up and put 00 at the end, and there is the answer.

91.—SQUARING THE DIGITS

IN four moves 73, 34, 48, 25, we can get 157,326,849, which is the square of 12,543. But the correct solution is 15, 84, 46, which gives us the number 523,814,769, the square of 22,887, which is in three moves only.

92.—DIGITS AND SQUARES

(1) 1,026,753,849 (the square of 32,043); (2) 9,814,072,356 (the square of 99,066).

93.—FIGURES FOR LETTERS

$$6,543 \times 98,271 = 642,987,153.$$

94.—SIMPLE MULTIPLICATION

HERE is an answer :

$$\begin{array}{r} 4539281706 \\ \times 2 \\ \hline 9078563412 \end{array}$$

If you divide the first number into pairs—45, 39, etc.—these can be arranged in any order so long as the 06 is not at the beginning or the 45 at the end.

95.—BEESWAX

THE key is as follows :

1 2 3 4 5 6 7 8 9 0
A T Q B K X S W E P

from which we get

$$\begin{array}{r} 917947476 \\ 408857923 \\ \hline 509089553 \end{array}$$

and BEESWAX represents the number 4,997,816.

96.—WRONG TO RIGHT

$$\begin{array}{r} 25938 \\ 25938 \\ \hline 51876 \end{array}$$

97.—LETTER MULTIPLICATION

$$\begin{array}{r} 4973 \\ 8 \\ \hline 39784 \end{array}$$

98.—DIGITAL MONEY

£	s.	d.
3	7	5
		8
<hr/>		
£26	19	4

99.—THE CONSPIRATORS' CODE

THE answer is as follows :

$$\begin{array}{r} 598 \\ 507 \\ 8047 \\ \hline 9152 \end{array}$$

There is no space to show the interesting working.

100.—DIGITAL SQUARES

THE only two solutions are 567, with its square, 321,489; and 854, with its square, 729,316. We need only examine cases where the digits in the root number sum to 9, 18, or 27; or 8, 17, or 26, and it can never be a lower sum than 317 to form the necessary six figures.

101.—FINDING A SQUARE

TAKING the six numbers in their order, the sums of their digits are :

46	31	42	34	25	34
1	4	6	7	7	7

Again adding, where necessary, the digits until we reach a single figure, we get the second row of numbers, which we call the digital roots. These may be combined in different triplets in eight different ways :

146	147	167	177	467	477	677	777
2	3	5	6	8	9	2	3

again giving the digital roots shown. Now, as shown in *Amusements in Mathematics*, the digital root of every square number must be either 1, 4, 7, or 9, so that the required numbers must have the roots 4, 7, 7, to be a square. The two 7's may be selected in three different ways. But if the fifth number is included, the total of the three will end in 189 or 389, which is impossible for a square, as the 89 must be preceded by an even figure or 0. Therefore the required numbers must be : 2,494,651 + 1,385,287 + 9,406,087 = 13,286,025, which is the square of 3,645.

As illustrating the value of this new method we may be allowed to quote from the late Professor W. W. Rouse Ball :

" This application is original on Mr. Dudeney's part. Digital properties are but little known to mathematicians, and we hope his example may serve to direct attention to the method. . . . In a certain class of arithmetical problems it is of great assistance."

102.—JUGGLING WITH DIGITS

$$7 + 1 = 8; 9 - 6 = 3; 4 \times 5 = 20.$$

103.—EXPRESSING TWENTY-FOUR

THE following is a simple solution (by G. P. E.) for three 7's :

$$-\sqrt{\frac{7}{7}}$$

And from this we obtain the answer for three 1's by substituting 1 for 7 in every case, and putting plus instead of minus. The puzzle is thus solved with all the nine digits.

104.—LETTER FIGURE PUZZLE

B and C must be either 6 and 2 or 3 and 5, and that in the third equation they are shown to be 3 and 5, since D must be 7. Then E must be 8 in order that $D \times E$ should show $C = 5$. Then the rest is easy, and we find the answer as follows : $A = 1$, $B = 3$, $C = 5$, $D = 7$, $E = 8$, $F = 9$, $H = 6$, $J = 4$, $K = 2$,
O.

105.—EQUAL FRACTIONS

THE five answers are as follows :

106.—DIGITS AND PRIMES

THE 4, 6, and 8 must come in the tens place, as no prime number can end with one of these, and 2 and 5 can only appear in the units place if alone. When those facts are noted the rest is easy, as here shown :

$$\begin{array}{r} 47 \\ 61 \\ 89 \\ 2 \\ 3 \\ 5 \\ \hline 207 \end{array}$$

107.—A SQUARE OF DIGITS

IN every one of the following eight sums all the nine digits are used once, and the difference between the successive totals is, throughout, 9 :

$$\begin{array}{r|l} 243 & 341 & 154 & 317 & 216 & 215 & 318 & \\ \hline 918 & 927 & 936 & 945 & 954 & 963 & 972 & 746 \end{array}$$

108.—THE NINE DIGITS

THE number 94,857,312, multiplied by 6, gives the product 569,143,872, the nine digits being used once, and once only, in each case.

109.—PERFECT SQUARES

SEVERAL answers can, of course, be found for this problem, but we think the smallest numbers that satisfy the conditions are :

$$\begin{aligned} a &= 10,430, b = 3,970, c = 2,114, d = 386. \\ a + b &= 10,430 + 3,970 = 14,400 = 120^2. \\ a + c &= 10,430 + 2,114 = 12,544 = 112^2. \\ a + d &= 10,430 + 386 = 10,816 = 104^2. \\ b + c &= 3,970 + 2,114 = 6,084 = 78^2. \\ b + d &= 3,970 + 386 = 4,356 = 66^2. \\ c + d &= 2,114 + 386 = 2,500 = 50^2. \\ &= 10,430 + 3,970 + 2 \\ &= 16,900 = 130^2. \end{aligned}$$

The general solution depends on the fact that every prime number of the form $4m+1$ is the sum of two squares. Readers will probably like to work out the solution in full.

110.—AN ABSOLUTE SKELETON

It can soon be discovered that the divisor must be 312, that 9 cannot be in the quotient because nine times the divisor contains a repeated figure. We therefore know that the quotient contains all the figures 1 to 8 once, and the rest is comparatively easy. We shall find that there are four cases to try, and that the only one that avoids repeated figures is the following :

$$312)10,114,626,600(32,418,675.$$

111.—ODDS AND EVENS

$$249)764,752,206(3,071,294.$$

$$249)767,242,206(3,081,294.$$

$$245)999,916,785(4,081,293.$$

$$245)997,466,785(4,071,293.$$

$$248)764,160,912(3,081,294.$$

$$248)761,680,912(3,071,294.$$

If the reader will work out each of these little sums in simple division he will find that they fulfil all the conditions required by the asterisks and O's and E's.

112.—SIMPLE DIVISION

DIVIDE 4,971,636,104 by 124,972, and the quotient is 39,782. The reader can now work out the little sum for himself, and he will find that all the conditions are fulfilled. If we were allowed additional 7's in the dividend, an answer

would be 7,471,076,104 divided by 124,972 equals 59,782.

113.—A COMPLETE SKELETON

THE first division sum is :

$$333)100,007,892(300,324,$$

and the second :

$$29)300,324(10,356.$$

114.—ELEMENTARY ARITHMETIC

THE answer must be $2\frac{3}{4}$. It is merely a sum in simple proportion: If 5 be 4, then $3\frac{1}{2}$ will be $2\frac{3}{4}$.

115.—THE EIGHT CARDS

You need only make the 8 and 9 change places, first turning the 9 round so as to change it to a 6. Then each column will add up 18.

116.—TRANSFERRING THE FIGURES

THE required number is :

which may be multiplied by 4 and the product divided by 5 by simply moving the 2 from the beginning to the end.

117.—A QUEER ADDITION

WRITE the following four numbers, composed of five odd figures, in the form of an addition sum, 11, 1, 1, 1, and they will add up 14.

118.—SIX SIMPLE QUESTIONS

(1) $8,111\frac{1}{2}$; (2) $18\frac{3}{4}$; (3) 7 and 1;
(4) $1\frac{1}{2}$; (5) $8\frac{1}{4}$; (6) $\frac{3}{8}$.

In the case of No. 6, "reversed" means turned upside down.

119.—THE THREE DROVERS

JACK had 11 animals, Jim 7, and Dan 21 animals, making 39 animals in all.

120.—PROPORTIONAL REPRESENTATION

THE number of different ways in which the ballot paper may be marked is 9,864,100.

121.—FIND THE NUMBERS

THE two numbers composed of 1's that sum and multiply alike are 11 and 11. In both cases the result is 12.1.

122.—A QUESTION OF CUBES

THE cubes of 14, 15, up to 25 inclusive (twelve in all) add up to 97,344, which is the square of 312. The next lowest answer is the five cubes of 25, 26, 27, 28, and 29, which together equal 315^2 .

123.—TWO CUBES

THE cube of 7 is 343, and the cube of 8 is 512; the difference, 169, is the square of 13.

124.—CUBE DIFFERENCES

THE cube of 642 is 264,609,288, and the cube of 641 is 263,374,721, the difference being 1,234,567, as required.

125.—ACCOMMODATING SQUARES

THE number is 225,625 (the squares of 15 and 25), making the square of 475.

126.—MAKING SQUARES

AN answer is as follows: 482, 3,362, 6,242, which have a common difference of 2,880. The first and second numbers sum to 62^2 , the first and third to 82^2 , and the second and third to 98^2 .

127.—FIND THE SQUARES

IF you add 125 to 100 and also to 164, you get two square numbers, 225 and 289, the squares of 15 and 17 respectively.

128.—FORMING SQUARES

THE officer must have had 1,975 men. When he formed a square 44×44 he would have 39 men over, and when he attempted to form a square 45×45 would be 50 men short.

129.—SQUARES AND CUBES

IF we make one number $625m^2$, and the other number double the first, we can get any number of solutions of a particular series. Thus, if we make $m = 1$, we get the answer $625^2 + 1,250^2 = 125^2$, and

130.—MILK AND CREAM

HALF a pint of skimmed milk must be added.

131.—FEEDING THE MONKEYS

THE smallest number of nuts is 2,179. The best way of solving this is to deal first with the first two cases, and find that 34 (or 34 added to 143 or any multiple of it) will satisfy the case for 11 and 13 monkeys. You then have to find the lowest number of this form that will satisfy the condition for the 17 monkeys.

132.—SHARING THE APPLES

THE ratio is clearly 6, 4, and 3, which sum to 13. Therefore the boys receive $\frac{3}{13}$, and $\frac{4}{13}$, or 78, 52, and 39 apples.

133.—SAWING AND SPLITTING

THE men must saw $3\frac{1}{3}$ cords of wood.

134.—THE BAG OF NUTS

THE five bags contained respectively 27, 25, 18, 16, 14 nuts. Each bag can be found by subtracting the other two pairs together from 100. Thus, $100 - (52 + 30) = 18$, the third bag.

135.—DISTRIBUTING NUTS

THERE were originally 1,021 nuts. Tommy received 256; Bessie, 192; Bob, 144; and Jessie, 108. Thus the girls received 300 and the boys 400, or 100 more, and Aunt Martha retained 321.

136.—JUVENILE HIGHWAYMEN

THE woman must have had 40 apples in her basket. Tom left her 30, Bob left 22, and Jim left 12.

137.—BUYING DOG BISCUITS

THE salesman supplied four boxes of 17 lbs. each, and two boxes of 16 lbs. each, which would make exactly the 100 lbs. required.

138.—THE THREE WORKMEN

ALEC could do the work in $14\frac{2}{3}$ days; Bill in $17\frac{2}{3}$ days; and Casey in $23\frac{1}{3}$ days.

139.—WORKING ALONE

SIXTY days and forty days.

140.—A CURIOUS PROGRESSION

THE answer is :

$$[1, \quad [2, \quad [3, \quad [4, \quad [5, = 153.$$

This "factorial" sign, of course, means

$$[4 = 1 \times 2 \times 3 \times 4 = 24, \text{ etc.}$$

141.—THE FIRST "BOOMERANG" PUZZLE

WHEN you are given the remainder after dividing by 3 multiply it by 70, the remainder by 5 multiply by 21, and the remainder by 7 multiply by 15. Add these results together and they will give you either the number thought of, or that number increased by some multiple of 105. Thus, if the number thought of

by 70, the remainder 4 multiplied by 21, and the remainder 2 multiplied by 15, added together make 184. Deduct 105, and you get 79—the number thought of.

142.—LONGFELLOW'S BEES

THE number of bees must have been 15.

143.—"LILIVATI" (A.D. 1150)

THE answer is 28. The trick lies in reversing the whole process—multiplying 2×10 , deducting 8, squaring the result, and so on. Remember, for example, that to increase by three-fourths of the product is to take seven-fourths. And in the reverse process, at this step, you take four-sevenths.

144.—BIBLICAL ARITHMETIC

THERE were seven in the Sunday school class. The successive numbers required by the questions in their order are as follows: 12, 7, 6, 10, 7, 50, 30, 5, 15, 4, 8.

145.—THE PRINTER'S PROBLEM

THE printer must have purchased the following twenty-seven types:

A A B C D E E E F G H I J L M N O O P
R R S T U U V V

146.—THE SWARM OF BEES

THERE were seventy-two bees.

147.—BLINDNESS IN BATS

THE fewest possible would be 7, and this might happen in either of three ways:

(1) 2 with perfect sight, 1 blind only in the right eye, and 4 totally blind.

(2) 1 with perfect sight, 1 blind in the

left eye only, 2 blind in the right eye only, and 3 totally blind.

(3) 2 blind in the left eye only, 3 blind in the right eye only, and 2 totally blind.

148.—THE MENAGERIE

As the menagerie contained two monstrosities—the four-footed bird and the six-legged calf—there must have been 24 birds and 12 beasts in all.

149.—SHEEP STEALING

THE number of sheep in the flock must have been 1,025. It will be found that no mutilation of any sheep was necessary.

150.—SHEEP SHARING

THE share of Charles is 3,456 sheep. readers will first have found Alfred's share, and then subtracted 25 per cent., but this will, of course, be wrong.

151.—THE ARITHMETICAL CABBY

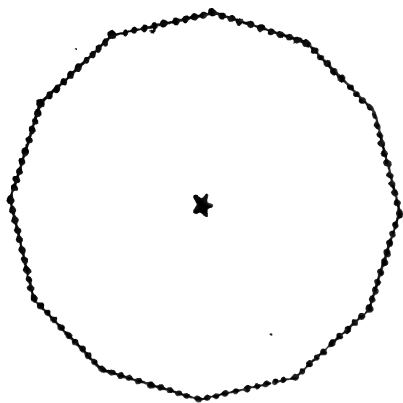
THE driver's number must have been 121.

152.—THE LENGTH OF A LEASE

THE number of years of the lease that had expired was 54.

153.—A MILITARY PUZZLE

THE illustration shows the supremely easy way of solving this puzzle! The central star is the officer, and the dots are the men.



A MILITARY PUZZLE

154.—MARCHING AN ARMY

THERE must have been 4,550 men. At first they were placed with 65 in front and 70 in depth; afterwards 910 in front and 5 in depth.

155.—THE ORCHARD PROBLEM

AT first he had 7,890 trees, which formed a square 88×88 , and left 146 trees over; but the additional 31 trees made it possible to plant a square 89×89 , or a total of 7,921 trees.

156.—MULTIPLYING THE NINE DIGITS

DORA was not to be caught by George's question. She, of course, immediately gave the correct answer, 0.

157.—COUNTING THE MATCHES

THERE were 36 matches in the box with which he could form a triangle 17, 10, 9,
(8,646)

the area of which was 36 sq. in. After 6 had been used, the remaining 30 formed a triangle 13, 12, 5, with an area of 30 sq. in.; and after using another 6, the 24 remaining would form a triangle 10, 8, 6, with an area of 24 sq. in.

158.—NEWSBOYS

THE Joneses won by 220 papers. The original number of papers in the stock must have been 1,020. Then Tom Smith sold 256, and his brother Ned sold 144, making 400 copies, while Billy Jones and his brother sold respectively 192 and 108, making 300 copies. So the Smiths were 100 ahead with 320 copies left over, which Jimmy Jones disposed of, leaving his side the winners by 620 to 400.

159.—THE YEAR 1927

1927.

160.—BOXES OF CORDITE

THE dump officer should give boxes of 18 until the remainder is a multiple of 5. Then, unless this is 5, 10, or 25, he gives this remainder in 15's and 20's. The biggest number for which this system breaks down is 72 plus 25, or 97. Of course, in the case of higher numbers, such as 133, where 108, in six boxes of 18, leaves 25, he would give only one box of 18, leaving 115, which he would deliver in one box of 15 and five boxes of 20. But in the case of 97, 72 is the first and only case leaving a multiple of 5—that is, 25.

161.—BLOCKS AND SQUARES

THE smallest number of blocks in each box appears to be 1,344. Surrounding the hollow square 34^2 , the first girl makes her square 50^2 , the second girl 62^2 , and the third girl 72^2 , with her four blocks left over for the corners.

162.—FIND THE TRIANGLE

THE sides of the triangle are 13, 14, and 15, making 14 the base, the height 12, and the area 84. There is an infinite number of rational triangles composed of three consecutive numbers, like 3, 4, and 5, and 13, 14, and 15, but there is no other case in which the height will comply with our conditions.

The triangles having three consecutive numbers for their sides, and having an integral area, are :

3	4	5
13	14	15
51	52	53
193	194	195
723	724	725, etc.

They are found very simply :

$$\begin{aligned} 52 &= 4 \times 14 - 4 \\ 194 &= 4 \times 52 - 14 \\ 724 &= 4 \times 194 - 52, \end{aligned}$$

or generally $U_n = 4 U_{n-1} - U_{n-2}$, or the general mathematical formula : Find x , so that $3(x^2 - 1)$ = a perfect square, where $2x$, $2x + 1$, $2x - 1$ are the sides of the triangle.

163.—DOMINO FRACTIONS

THE illustration shows how to arrange the dominoes so that each of the three

rows of five sum to 10. Give every fraction the denominator 60. Then the

10

-10

2

-10

numerators of the fractions used must sum to 1,800, or 600 in each row, to produce the sum 10. The selection and adjustment require a little thought and cunning.

164.—COW, GOAT, AND GOOSE

As cow and goat eat $\frac{1}{48}$ in a day, cow and goose $\frac{1}{60}$ in a day, and goat and goose $\frac{1}{80}$ in a day, we soon find that the cow eats $\frac{3}{800}$ in a day, the goat $\frac{2}{800}$ in a day, and the goose $\frac{1}{800}$ in a day. Therefore, together they will eat $\frac{3}{800}$ in a day, or $\frac{1}{40}$. So they will eat all the grass in the field in 40 days, since there is no growth of grass in the meantime.

165.—POSTAGE STAMPS PUZZLE

THE number of postage stamps in the album must have been 2,519.

166.—HENS AND TENS

NINE shillings and nine pence.

167.—THE CANCELLED CHEQUE

It can be easily shown that the original square number must have ended in a 5, and when multiplied by 113 must also end in 5. Then the number of the cheque must have ended in 25, and the complete number must lie between 885 and 8,845. The only numbers available are 1,225 and 7,225. The first will not work, but 7,225 multiplied by 113 gives us 816,425, or 81—64—25.

168.—MENTAL ARITHMETIC

THE numbers are 3 and 5. Their product, added to the sum of their squares, produces 97.

The general solution to this problem is as follows :

Calling the numbers a and b , we have :

$$\therefore b + a = -2am + bm^2,$$

$$\therefore b = \frac{a(2m+1)}{m^2-1} \text{ in which } m \text{ may be}$$

any whole number greater than 1, and a is chosen to make b rational. The general values are $a = m^2 - 1$ and $b = 2m + 1$.

169.—SHOOTING BLACKBIRDS

TWICE 4 added to 20 is 28. Four of these (a seventh part) were killed, and these were those that remained, for the others flew away.

170.—THE SIX NOUGHTS

100
330
505
077
099
IIII

171.—MULTIPLICATION DATES

THERE are 215 different dates in this century complying with the conditions, if we include such cases as 25/4/00. The most fruitful year was 1924, when we get the seven cases: 24/1/24, 12/2/24, 2/12/24, 8/3/24, 3/8/24, 6/4/24, 4/6/24. One has only to seek the years containing as many factors as possible.

172.—CURIOUS MULTIPLICAND

THE number is 142,857. This is, of course, the recurring decimal fraction of one-seventh.

173.—SHORT CUTS

To multiply 993 by 879, proceed as follows: Transfer 7 from 879 to 993, and we get 872 and 1,000, which, multiplied together, produce 872,000. And 993 less 872 is 121, which, multiplied by the 7, will produce 847. Add the two results together, and we get 872,847 as the correct answer.

174.—MORE CURIOUS MULTIPLICATION

THE number is 987,654,321, which, when multiplied by 18, gives 17,777,777,778,

with 1 and 8 at the beginning and end. And so on with the other multipliers, except 90, where the product is 88,888,888,890, with 90 at the end.

175.—CROSS-FIGURE PUZZLE

TAKE the group of seven squares in the top right-hand corner. Horizontal K must be either 211, 112, or 121, to sum

1	0	2	4	/	9	/	8	6	4	9
3	/	5	4	3	1	4	9	9	/	2
3	6	/	5	4	2	8	9	/	1	6
1	6	9	/	3	2	4	/	1	1	1
/	4	7	7	/	5	/	1	2	1	/
4	3	2	4	5	/	1	1	2	1	1
/	6	2	5	/	1	/	4	2	1	/
6	2	5	/	3	2	1	/	2	1	0
5	3	/	7	3	3	3	2	/	1	3
6	/	4	2	8	2	6	1	6	/	9
1	2	9	6	/	1	/	6	4	9	8

to 4. Complete group for the three cases and you will find that the third one alone will work to enable us to solve the diagonal (up), $CC = 12$. So we can write in these seven numbers as shown in the said diagonal. Now we can complete diagonal F (down) by writing 4 at top of last column. We can also complete diagonal K (down) by writing in the two 1's. Then we can complete horizontal S and W, and as we shall find that the diagonal EE (up) sums to 8, and both figures must be the

same, we can complete that second group.

Now we can complete vertical Y, then horizontal BB, vertical X, horizontal X, vertical U, diagonal L (down), horizontal P, vertical L, all in order, and the two groups in the bottom left-hand corner are complete. Next we can complete diagonal J (down), diagonal Z (up), diagonal L (up), vertical A, horizontal A, vertical C, horizontal H, vertical B, diagonal H (down), diagonal X (up), horizontal M, diagonal B (down), horizontal Z, vertical N, horizontal Q, vertical R, horizontal DD, horizontal V, vertical D, and all is done.

176.—COUNTING THE LOSS

THE number killed was 472. If the reader checks the figures for himself he will find that there were 72 men in each of the four gangs set to work in the end.

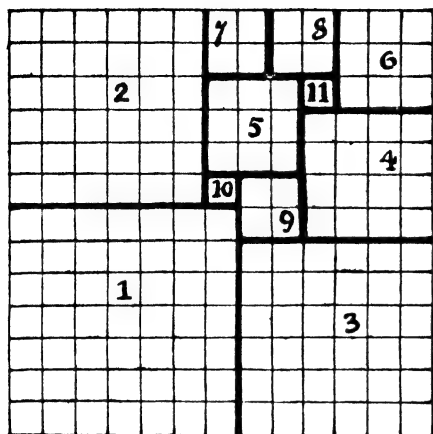
The general solution of this is obtained from the indeterminate equation

$$\overline{768}$$

which must be an integer, where $x =$ number of survivors. Solving in the usual way, we get $x = 528$, \therefore number killed $1000 - 528 = 472$.

177.—SQUARE OF SQUARES

THERE is, we believe, practically only one solution to this puzzle, here shown. The fewest pieces must be 11, the portions must be of the sizes given, the three largest pieces must be arranged as



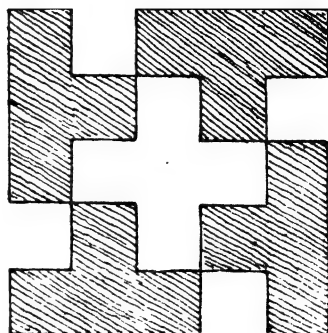
shown, and the remaining group of eight squares may be "reflected" but cannot be differently arranged.

178.—STARS AND CROSSES

THE illustration shows how the square may be cut into four pieces, each of the same size and shape, so that each part shall contain a star and a cross.

179.—GREEK CROSS PUZZLE

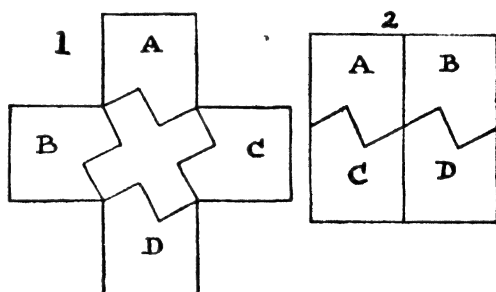
PLACE the four pieces together in the manner shown, and the symmetrical Greek cross will be found in the centre.



GREEK CROSS PUZZLE

180.—SQUARE AND CROSS

IF we cut the smaller Greek cross in the manner shown in diagram 1, the



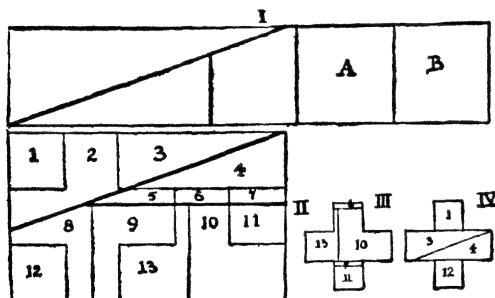
four pieces A, B, C, and D will fit together and form a perfect square, as shown in diagram 2.

181.—THREE GREEK CROSSES FROM ONE

CUT off the upper and lower arms of your large cross and place them in the positions A and B, so as to form the rectangle in Fig. I. Now cut th

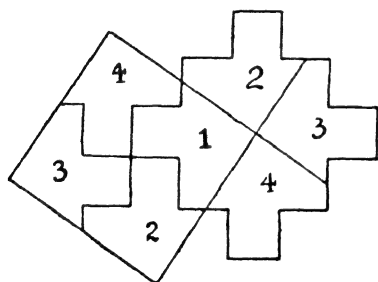
shown, into three pieces so that the five will form the rectangle in Fig. II. This figure may be said to be built up of fifteen equal squares, five of which will

be required for each new cross. Cutting is then not difficult, and 2, 5, 8, 9 clearly form one cross; 13, 6, 10, 7, and 11 will form the second cross, as in Fig. III; and 1, 3, 4, 12 will form the third cross, as in Fig. IV. The smaller arms are one-third of the area of the larger arms. It is shown on page 232 of *The Canterbury*



Puzzles how to find the side of the smaller squares. The rest is now easy.

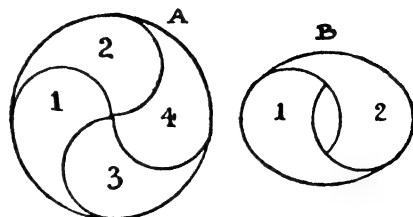
182.—MAKING A SQUARE



The diagram will make it clear how the figure should be cut into four pieces of the same size and shape that will fit together and form a perfect square.

183.—TABLE-TOP AND STOOLS

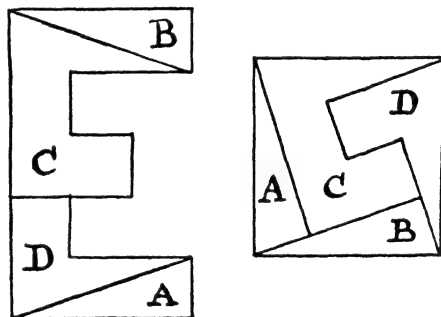
FIG. A shows the circle divided into four equal pieces, forming the Great Monad,



and in Fig. B we have two pieces reassembled to form one of the two stools, the other stool being similarly constructed from 3 and 4. Unfortunately the hand-holes are across instead of lengthways, but no condition is broken.

184.—DISSECTING THE LETTER E

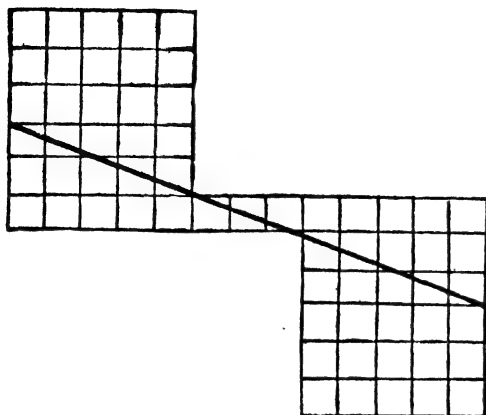
The diagrams will show how the four pieces may be cut so as to form a perfect



square. The pieces A and D are turned over in accordance with the conditions allowed.

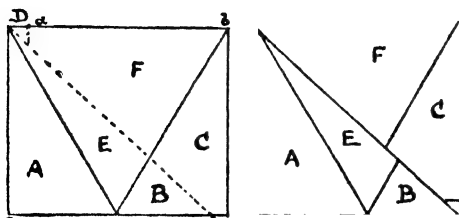
185.—DISSECTED CHESSBOARD

may be put together in a different way, so that, on first sight, it may appear that we have lost a cell, there now being



only sixty-three of these. The explanation, as in the case of the other fallacy, lies in the fact that the lines formed by the slanting cuts do not coincide in direction. In the case of the fallacy shown in the puzzle here, if the pieces are so replaced that the outside edges form a true rectangle, there will be a long diamond-shaped space not covered, exactly equal in area to the supposed extra cell. In this case the pieces, if truly laid, will overlap, and the area of the overlapping is exactly equal to the supposed missing cell. This is the simple explanation in a nutshell.

186.—TRIANGLE AND SQUARE

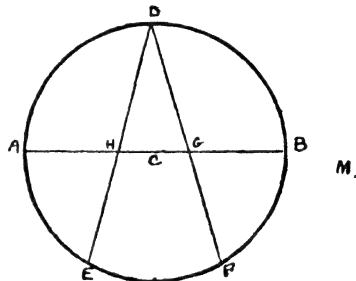


Cut one triangle in half, and place the pieces together as in Fig. 1. Now cut in the direction of the dotted lines, making ab and cd each equal to the side of the required square. Then fit together the six pieces as in Fig. 2, sliding the pieces F and C upwards to the left, and bringing down the little piece D from one corner to the other.

187.—CHANGING THE SUIT

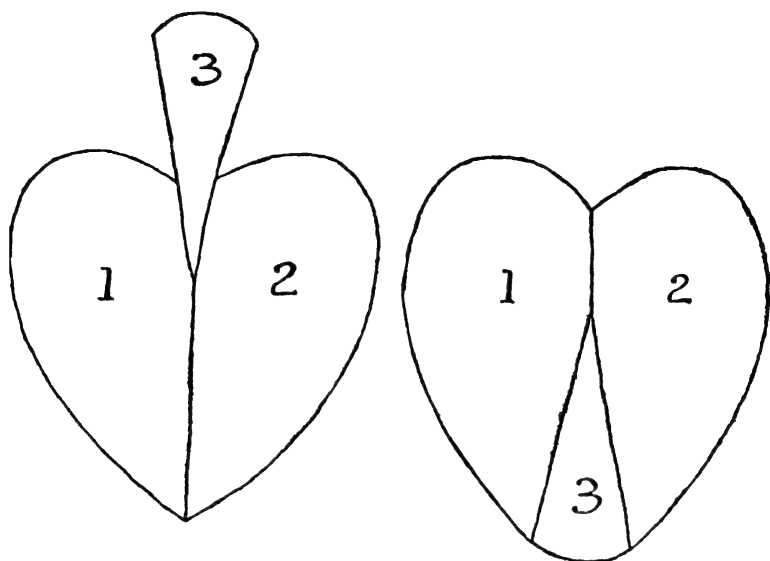
THE diagram (p. 152) shows how the spade may be cut into three parts that will fit together and form a heart.

188.—SQUARING THE CIRCLE



If you make a rectangle with one side equal to the diameter, and the other three times the diameter, then the diagonal will be something near correct. In fact, in figures it would be 1 to 3.1622. The method we recommend is the following :

In the diagram, A B is the diameter. Bisect the semicircle in D. Now, with



CHANGING THE SUIT

the radius AC mark off the points E and F from A and B, and draw the lines DE and DF. The distance DG, added to the distance GH, gives a quarter of the length of the circumference (IK), correct within a five-thousandth part. IKLM is the length of complete straight line.

There is another way, correct to a seventeen-thousandth part, but it is a little more difficult.

189.—PROBLEM OF THE EXTRA CELL

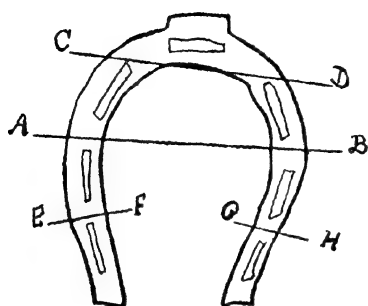
THE fallacy lies in the fact that the oblique edges of the pieces do not coincide in direction. If you carefully lay out the pieces so that the outer edges form a true rectangle, then there is a long diamond-shaped space in the

middle uncovered, as in the diagram. This space is exactly equal in area to one of the little square cells. There-

fore we must deduct one from 65 to get 64 as the actual area covered. The size of the diamond-shaped piece has been exaggerated to make it quite clear to the eye of the reader.

190.—A HORSESHOE PUZZLE

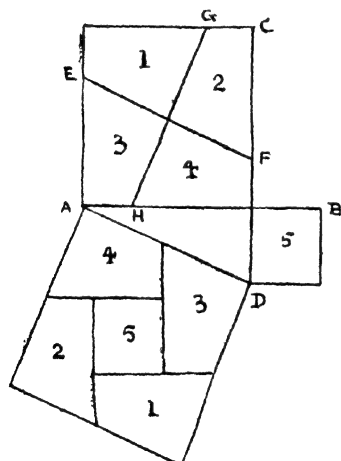
FIRST make cut A B. Then so place the three pieces together that with one clip of the scissors you can make the cut CD together with E F and G H.



A HORSESHOE PUZZLE

191.—TWO SQUARES IN ONE

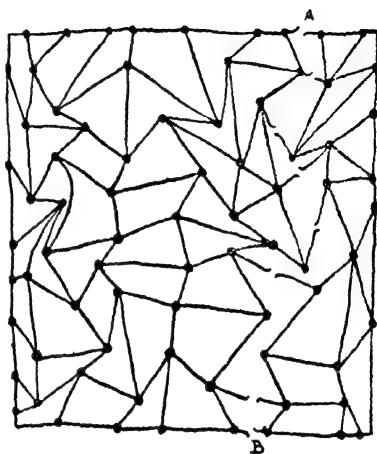
PLACE the two squares together, so that AB and CD are straight lines. Then find the centre of the larger square, and draw through it the line EF parallel to



A.D. If you now make GH (also through the centre) perpendicular to EF, you can cut out the four pieces and form the lower square, as shown.

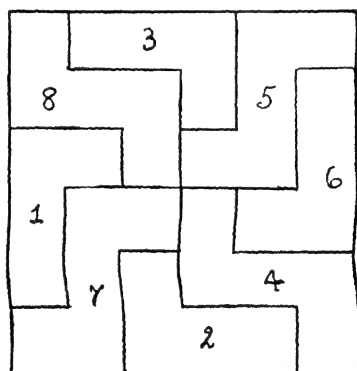
(8,646)

192.—THE SUBMARINE NET



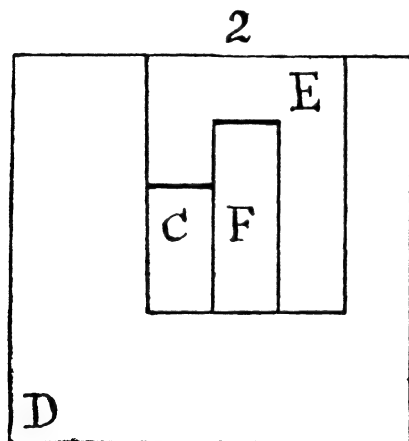
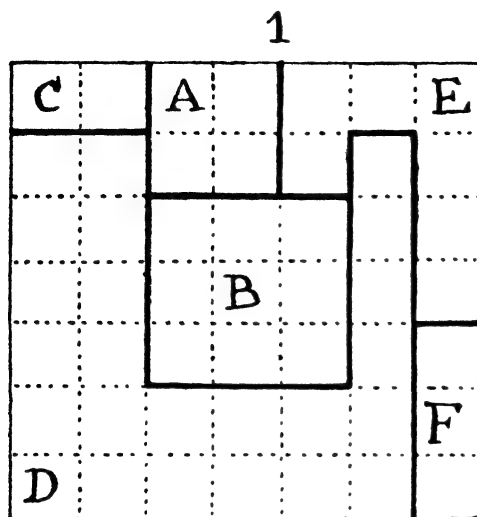
THE illustration will show the best way of cutting the net. It will be seen that eight cuts are made from A to B, dividing the net into two parts.

193.—SQUARE TABLE-TOP



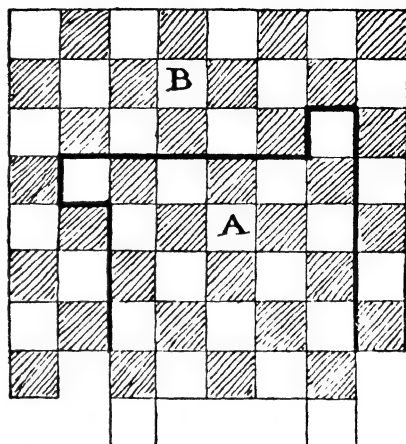
THE eight pieces of veneer may be fitted together, as in the illustration, to form a perfect square, and the arrangement is symmetrical and pleasing.

194.—CUTTING THE VENEER



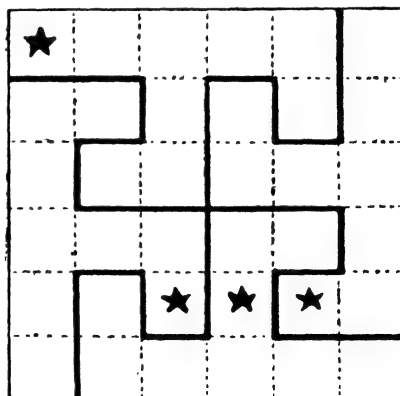
THE illustration will show clearly how the veneer may be cut. Squares A and B are cut out entire, as in Fig. 1, and the four pieces C, D, E, F will fit together, as in Fig. 2, to form a third square.

195.—IMPROVISED CHESSBOARD



Cut out the piece A, and inset it again after having given it a quarter turn in a clockwise direction, and the chessboard will be formed.

196.—THE FOUR STARS



THE diagram explains itself. The dark lines indicate the cuts, which divide the square into four pieces, each of the same

size and shape, and each containing a star and one of the four central squares.

197.—ECONOMICAL DISSECTION

THOUGH the cubic contents are sufficient to make twenty-five pieces, only twenty-four can actually be cut from the block. First reduce the length of the block by half an inch. The smaller piece cut off is the portion that cannot be used. Cut the larger piece into three slabs, each one and a quarter inches thick, and eight blocks may be cut out of each slab.

198.—THE PATCHWORK CUSHION



THE illustration shows how the twenty pieces may form a perfect square.

199.—THE HIDDEN STAR

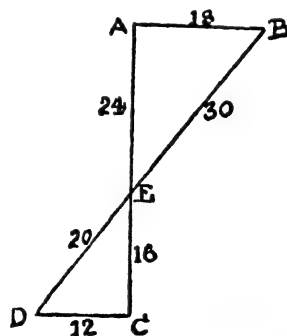
THE illustration shows the symmetrical star in its exact position in the silk patchwork cloth. All the other pieces contributed are omitted for the sake of clearness, and it can be at once located on reference to the illustration given with the puzzle. It is surprising how bewildering it is to find the star until



you have been once shown it, or have found it, and then it will appear pretty obvious.

200.—MEASURING THE RIVER

MEASURE any convenient distance along the bank from A to C, say 40 yards. Then measure any distance perpendicularly to D, say 12 yards. Now sight

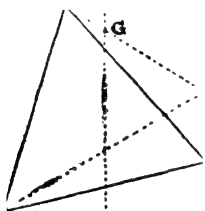


along DB and find the point E. You can then measure the distance from A to E, which will here be 24 yards, and from E to C, which will be 16 yards.

Now $AB : DC = AE : EC$, from which it is evident that AB , the width of the river, must be 18 yards.

201.—SQUARE AND TRIANGLE

FOLD the square in half and make the crease FE . Fold the side AB so that the point B lies on FE , and you will get the points G and H from which you can



fold HGJ . While B is on G , fold AB back on AH , and you will have the line AK . You can now fold the triangle AJK , which is the largest possible equilateral triangle obtainable.

202.—A GARDEN PUZZLE

THE trapezium will be inscribable in a circle. Half the sum of the sides is 29. From this deduct the sides in turn, and we get 9, 13, 17, 19, which, multiplied together, make 37,791. The square root of this = 194.4 square rods, will be the area.

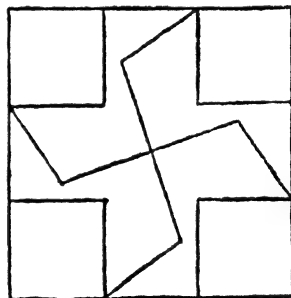
203.—A TRIANGLE PUZZLE

If you extend the following table you may get as many rational triangles, with consecutive numbers, as you like.

P.	Q.	Height.	Area.
2	4	3	6
8	14	12	84
30	52	45	1,170
112	194	168	16,296
418	724	627	226,974
1,560	2,702	2,304	3,161,340

Here three times the square of P , added to 4, will make the square of Q . Every value of P is four times the last number less the previous one, and Q is found in the same way after the first step. The height is half as much again as P , and the area is the height multiplied by half of Q . The middle number of our three sides will always be found as Q . The last line will give us the first case where the area is divisible by 20. The triangle is 2,701, 2,702, 2,703, with height 2,340.

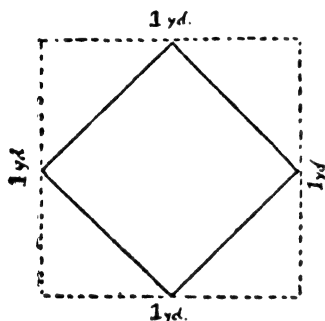
204.—THE DONJON KEEP WINDOW



THE illustration will show how the square window may be divided into eight lights "whose sides are all equal." Every side of the pane is of the same length. It was understood (though not actually stated) that the lights should be all of the same area, but the four

irregular lights are each one-quarter larger than the square lights. And neither the shape nor the number of sides of the lights are equal. Yet the solution strictly complies with the conditions as given. If you shut out all these tricks and quibbles in a puzzle you spoil it by overloading the conditions. It is better (except in the case of competitions) to leave certain things to be understood.

205.—THE SQUARE WINDOW



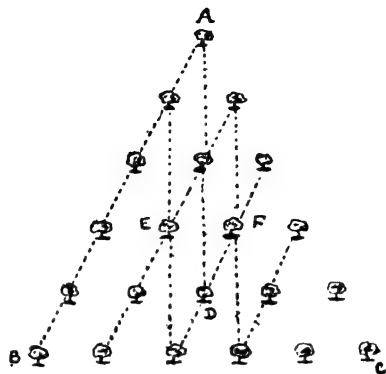
THE diagram shows the original window, a yard square. After he had blocked out the four triangles indicated by the dotted lines, he still had a square window, as seen, measuring a yard in height and a yard in breadth.

206.—THE TRIANGULAR PLANTATION

THE number of ways in which 3 trees may be selected from 21 is

$$\frac{20}{1} \times \frac{20}{2} \times \frac{19}{3}, \text{ or } 1,330;$$

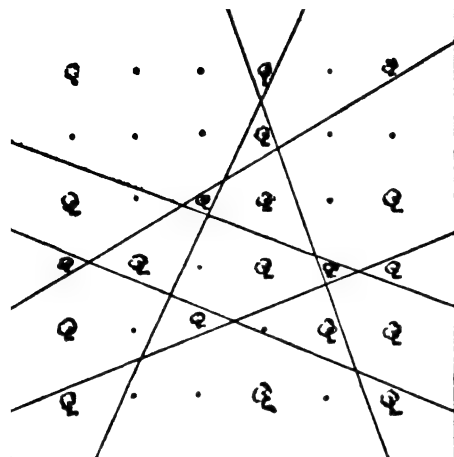
and a triangle may be formed with any one of these selections that does



not happen to be three in a straight line. Let us enumerate these cases of three in a line. Three trees may be selected from the dotted line, AB, in 20 ways; from the next line of 5 trees parallel with it, in 10 ways; from the next line of 4, in 4 ways; and from the next parallel of 3 trees, in 1 way—making, in all, 35 ways in that direction. Similarly BC and the lines parallel with it will give 35 ways, and AC and the lines parallel with it, 35 ways. Then AD and the two lines parallel with it will give 3 ways, and similarly BF and CE, with their parallels, will give 3 ways each. Hence 3 trees in a straight line may be selected in $35 + 35 + 35 + 3 + 3 + 3 = 114$ different ways. Therefore $1,330 - 114 = 1,216$ must be the required number of ways of selecting three trees that will form the points of a triangle.

207.—SIX STRAIGHT FENCES

THE illustration explains itself. The six straight fences are so drawn that every one of the 20 trees is in a separate enclosure. We stated that 22 trees



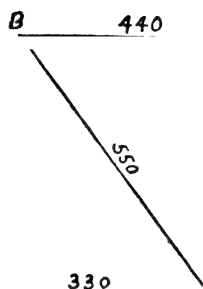
might be so enclosed in the square by six straight fences if their positions were more accommodating. We will here state that in such a case every line must cross every other line without any two crossings coinciding. As there are in our puzzle only 20 trees, this is not necessary, and it will be seen that four of the fences cross only four others instead of five.

208.—DIVIDING THE BOARD

THE distance from the end at which the cut must be made to divide the board into two equal parts is 5.8114 feet nearly.

209.—A RUNNING PUZZLE

EACH side of the field is 440 yards; B A E is a right-angled triangle, A E being 330 yards and B E 550 yards. Now, if Brown could run 550 yards while Adams ran 360 ($330 + 30$), then Brown can run the remaining 110 yards while Adams runs 72 yards. But $30 + 72 = 102$

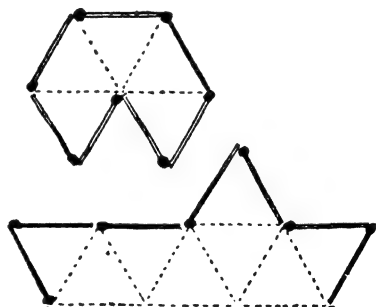


yards leaves Adams just 8 yards behind. Brown won by 8 yards.

210.—PAT AND HIS PIG

THE pig will run and be caught at $66\frac{2}{3}$ yards, and Pat will run $133\frac{1}{3}$ yards. The curve of Pat's line is one of those curves the length of which may be exactly measured. But we have not space to go into the method.

211.—THE TWENTY MATCHES

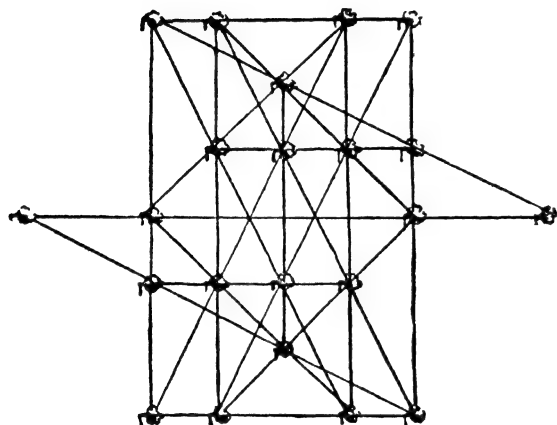


THE illustration shows how two enclosures may be formed with 13 and 7 matches respectively, so that one area shall be exactly three times as large as

the other, for one contains five of those little equilateral triangles, and the other fifteen.

There are other solutions.

212.—TRANSPLANTING THE TREES



THE illustration explains itself. Only 6 trees have been transplanted, and they now form twenty rows with 4 trees in every row.

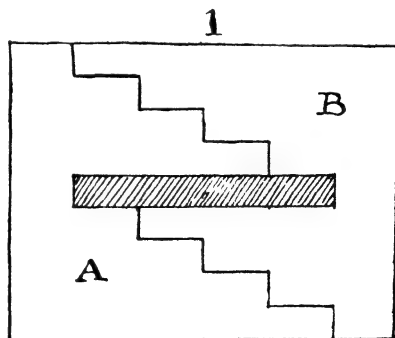
213.—A SWASTIKLAND MAP

map is here reproduced. The Lord High Keeper of the Maps had introduced that little line dividing A and B by mistake, and this was his undoing. A, B, and C must be different colours. Except for this slip, two colours would have been

214.—COLOURING THE MAP

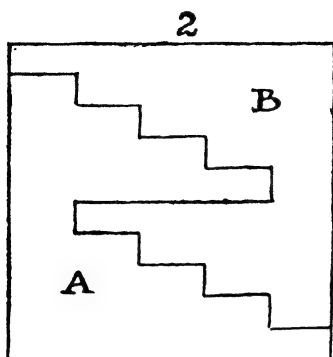
Two! The map requires four colours. It has been proved in *Modern Puzzles* that no map can require more. If the boy had three pigments (red, blue, and yellow) in his box, he could have obtained green, orange, or purple by mixing any two. But he cannot obtain four colours from fewer than three; consequently, there must have been only two ("not enough colours by one") in his box.

215.—THE DAMAGED RUG



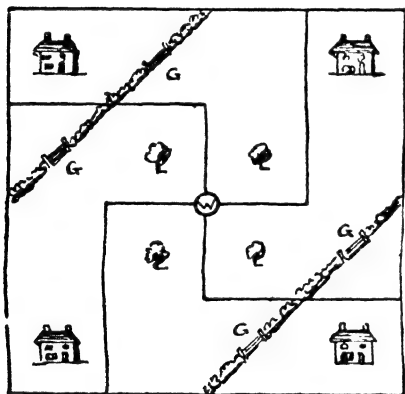
THREE different colours are necessary. The bottom right-hand corner of the

If we cut as in Fig. 1, the two pieces will fit together, as in Fig. 2, and form a



square. The steps are 2 ft. wide and 1 ft. in height.

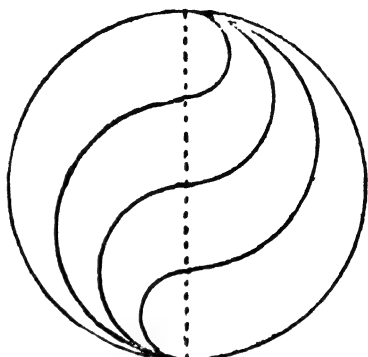
216.—THE FOUR HOUSEHOLDER



THE simplest, though not the only solution, is that shown in our illustration, which explains itself.

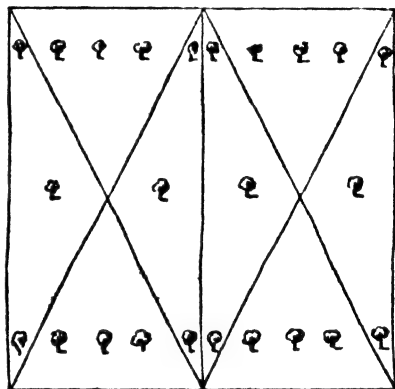
217.—THE THREE FENCES

To divide a circular field into four equal parts by three fences of equal length first divide the diameter of circle in four parts and then describe semicircles on each side of the line in the manne



shown in the diagram. The curved lines will be the required fences.

218.—THE FARMER'S SONS

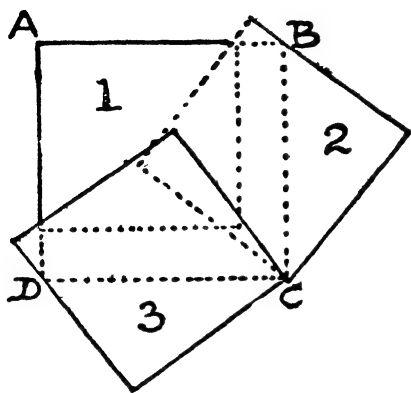


THE illustration shows the very simple solution to this little puzzle. The land is divided into eight equal parts, each part containing three trees.

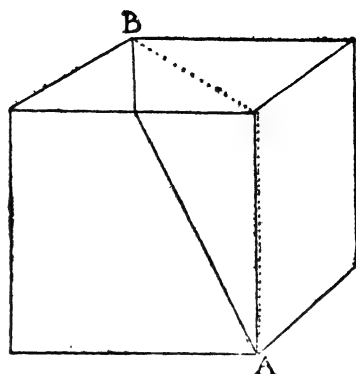
219.—THREE TABLECLOTHS

THE three tablecloths, each 4 ft. by 4 ft., will cover a table 5 ft. 1 in. by 5 ft. 1 in. if laid in the manner here shown. A B C D is the table-top, and 1, 2, and 3

SOLUTIONS

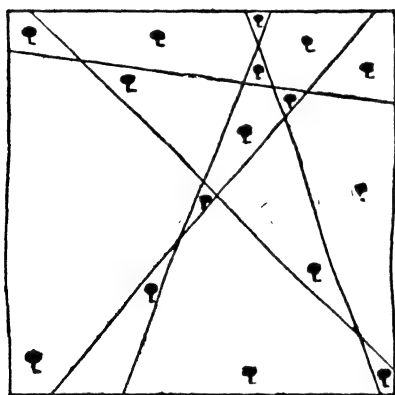


are the three square cloths. Portions of 2 and 3, of course, fall over the edge of the table.



the dotted line that will probably have suggested itself to the reader. This is longer, and would take more time.

220.—THE FIVE FENCES



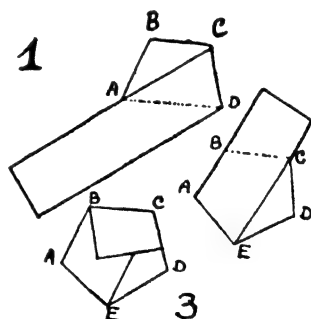
THE illustration explains itself.

221.—THE FLY'S JOURNEY

A CLEVER fly would select the route shown by the line in the illustration, which will take him 2.236 minutes. He will not go in the direction indicated by

222.—FOLDING A PENTAGON

By folding A over, find C, so that BC equals AB. Then fold as in Fig. 1, across the point A, and this will give you the point D. Now fold as in Fig. 2, making the edge of the ribbon lie along



A B, and you will have the point E. Continue the fold as in Fig. 3, and so on, until all the ribbon lies on the pentagon. This, as we have said, is simple, but it is interesting and instructive.

223.—THE TOWER OF PISA

THE ball would come to rest after travelling 218 ft. $9\frac{1}{2}$ in. This is an extremely close approximation.

224.—THE TANK PUZZLE

(1) THE water rises 1.8 inches, and (2) rises an additional 2.2 inches.

225.—AN ARTIST'S PUZZLE

THE canvas must be 10 in. in width and 20 in. in height; the picture itself 6 in. wide and 12 in. high. The margin will then be as required.

226.—THE CIRCULATING MOTOR-CAR

As the outside wheels went twice as fast as the inside ones, the circle they described was twice the length of the inner circle. Therefore, one circle had twice the diameter of the other, and, since the wheels were 5 ft. apart, the diameter of the larger circle was 20 ft. Multiply 20 ft. by 3.1416 (the familiar approximate value for "pi"), and we get 62.832 ft. as the length of the circumference of the larger circle.

227.—A MATCH-BOARDING ORDER

THE answer is: 8 pieces of 20 ft., 1 piece of 18 ft., and 7 pieces of 17 ft. Thus there are 16 pieces in all, measuring together 297 ft., in accordance with the conditions.

228.—THE LADDER

THE distance from the top of the ladder to the ground was $\frac{1}{5}$ of the length of the ladder. Multiply the distance from the wall—4 yards—by the denominator of this fraction—5—and you get 20. Now deduct the square of the numerator from the square of the denominator of $\frac{1}{5}$, and you have 9, which is the square of 3. Finally, divide 20 by 3, and there is the answer $6\frac{2}{3}$ yards.

229.—GEOMETRICAL PROGRESSION

$$1 + 3 + 9 + 27 + 81 = 121 = 11^2,$$

and

$$1 + 7 + 49 + 343 = 400 = 20^2.$$

230.—IN A GARDEN

THE garden bed must have been 14 ft. long and 10 ft. in width.

231.—THE ROSE GARDEN

A G

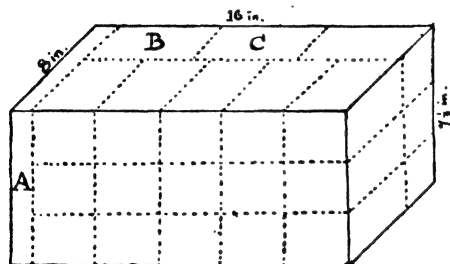
MAKE AD a quarter of the distance AB, and measure DE and AF each a quarter of BC. Now, if we make G the same distance from E that D is from F, then AG is the correct width of the path. If the garden is, for example, 12 ft. by 5 ft.,

the path will be 1 ft. wide, yet it cannot always be given in exact figures, though correct in measurement.

232.—A PAVEMENT PUZZLE

ONE floor was 38 ft. (1,444 stones) and the other 26 ft. square (676 stones).

233.—THE NOUGAT PUZZLE



FIRST cut off the piece marked A from the end, 1 in. thick. The remainder can then be cut in the manner shown, into twenty-four pieces of the required size, $5 \times 3 \times 2\frac{1}{2}$ in. All but four of the pieces are visible—two under B and two under C.

234.—PILE DRIVING

THE reader will probably give the answer as 42 ft., but there is a little trap in the puzzle. The part embedded in the mud must also be considered as "under water."

The correct answer is, therefore, 26 ft., 3 in.

235.—AN EASTER EGG PROBLEM

THE volumes of similar solids are as the cubes of corresponding lengths. The

simplest answer, to be exact as required, is that the three small eggs were $1\frac{1}{2}$ in., 2 in., and $2\frac{1}{2}$ in. respectively in length. The cubes of these numbers are $\frac{27}{8}$, 8, and $1\frac{1}{8}$, the sum of which is exactly 27—the cube of 3. The next easiest answer is $2\frac{2}{3}$ in., 2 in., and $\frac{1}{2}$ in. But there is an infinite number of answers.

236.—THE PEDESTAL PUZZLE

THE man made a box $3 \times 1 \times 1$ ft. inside, and into this he placed the pedestal. Then he filled the box with fine dry sand, shaking it down and levelling the top. Then he took out the pedestal, and the sand was shaken down and levelled, when the surface was found to be exactly 2 ft. from the top of the box. It was, therefore, obvious that the pedestal, when completed, contained 2 cubic ft. of wood, and that 1 cubic ft. had been removed.

237.—THE MUDBURY WAR MEMORIAL

THE number of posts in hand must have been 180, and the length of the enclosing line 330 ft. Then, at a foot asunder, they would require 150 more, but at a yard apart 110 would suffice, and they would have 70 too many.

238.—A MAYPOLE PUZZLE

THE height of the pole above ground must have been 50 ft. In the first case it was broken at a distance of 29 ft. from the top, and in the second case 34 ft. from the top.

239.—THE BELL ROPE

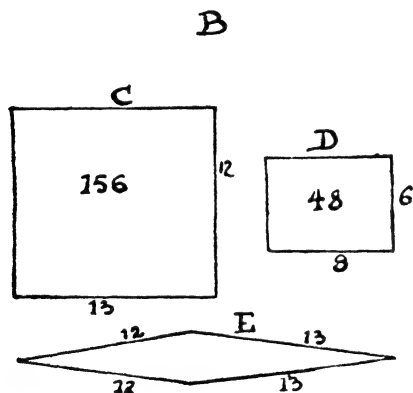
THE bell rope must have been 32 ft. $1\frac{1}{2}$ in. in length from ceiling to floor.

240.—COUNTING THE TRIANGLES

THERE are various ways of making the count, and the answer is 35.

241.—A HURDLES PUZZLE

THE old answer is that you can arrange them as in A, and then, by adding one more hurdle at each end, as in B, you double the area. No particular form was stated. But even if you admit that the original pen was 24×1 the answer



fails, for if you arrange the 50 as in Fig. C, the area is increased from 24 square hurdles to 156, with accommodation for 650 sheep with no extra hurdles. Or you can double the area, as in D, with 28 hurdles only. If all the hurdles must be used you might construct it as in Fig. E.

242.—CORRECTING A BLUNDER

THE correctness of the diagram can be easily proved, since the squares of 15 and 20 equal the square of 25; the squares of 15 and 36 equal the square of 39; and the squares of 15 and 8 equal the square of 17. Also, $20 + 8 = 28$. If a right-angled triangle had been



allowed, the one on the left, 15, 25, 20, would itself give the solution, since the height on the base 25 would be 12, and the median line $12\frac{1}{2}$.

Perhaps our readers would like to try their hand at constructing the general solution to triangles of this class.

243.—THE SQUIRREL'S CLIMB

THE squirrel climbs 5 ft. in ascending 4 ft. of the pole. Therefore he travels 20 ft. in a 16-ft. climb.

244.—SHARING A GRINDSTONE

THE first man should use the stone until he has reduced the radius by 1.754 in. The second man will then reduce it by an additional 2.246 in., leaving the last man 4 in. and the aperture. This is a very close approximation.

245.—MAGIC FIFTEEN PUZZLE

MOVE the counters in the following order: 12, 8, 4, 3, 2, 6, 10, 9, 13, 15, 14, 12, 8, 4, 7, 10, 9, 14, 12, 8, 4, 7, 10, 9, 6, 2, 3, 10, 9, 6, 5, 1, 2, 3, 6, 5, 3, 2, 1, 13,

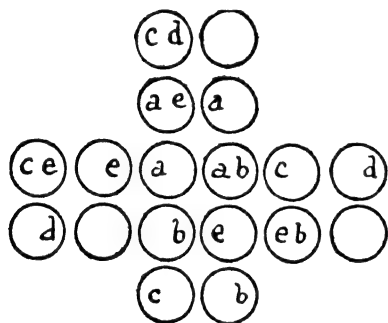
14, 3, 2, 1, 13, 14, 3, 12, 15, 3—fifty moves in all.

246.—TRANSFERRING THE COUNTERS

THE two additional counters should be placed one on the fourth square in the second row from the top, and the other in the second square in the fourth row. The puzzle is then quite possible, and so easy that it is quite unnecessary to give all the moves.

247.—THE COUNTER CROSS

THERE are 19 different squares to be indicated. Of these, nine will be of the size shown by the four A's in the diagram, four of the size shown by the B's, four of



the size shown by the C's, and two of the size shown by the D's. If you now remove the six coins marked "E," not one of these squares can be formed from the counters that remain.

248.—FOUR IN LINE

THERE are nine fundamentally different arrangements, as shown in the illustra-

tion on p. 166, the first A being the arrangement given as an example. Of these, D, E, and I each give eight solutions, counting reversals and reflections as explained, and the others give only four solutions each. There are, therefore, in all, forty-eight different ways in which the four counters may be placed on the board, so that every square shall be in line with at least one counter.

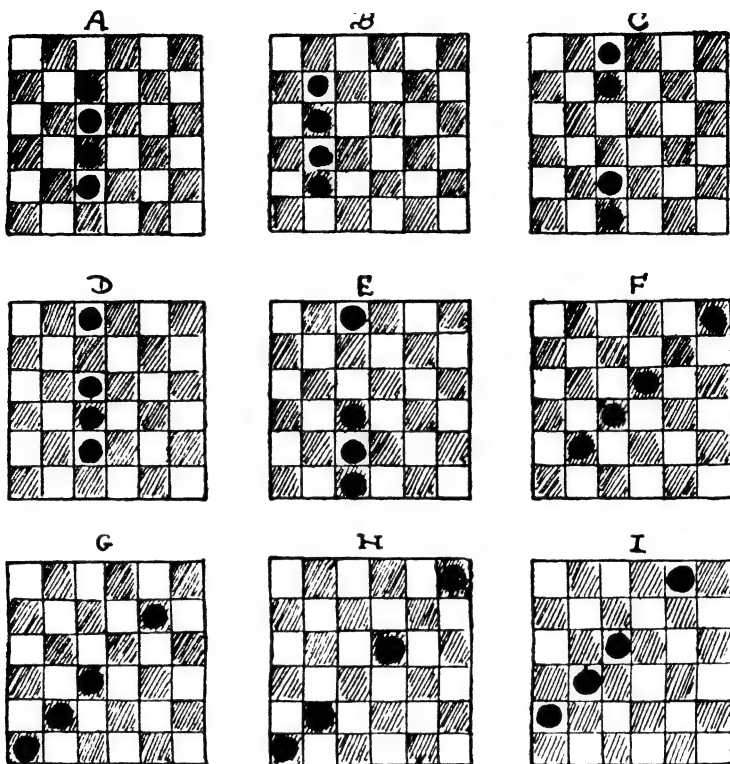
It may interest the reader to know that on a chessboard, 8×8 , five counters may be placed in line under precisely the same conditions in four fundamental different ways, producing twenty different solutions in all. The arrangements are given in the solution to No. 311, "The Five Dogs Puzzle," in the book *Amusements in Mathematics*.

249.—ODDS AND EVENS

THE fewest possible moves are 24. Play as follows. It is only necessary to give, by the letters, the circles from which and to which the counters are moved. Only a single counter can be moved at a time. E to A, E to B, E to C, E to D, B to D, E to B, C to B, A to B, E to C, E to A, B to A, C to E, B to C, A to C, B to A, C to B, C to A, B to A, E to C, E to B, C to B, D to E, D to B, E to B—24

250.—ADJUSTING THE COUNTERS

MAKE the exchanges of pairs as follows: (1—7, 7—20, 20—16, 16—11, 11—2—24), (3—10, 10—23, 23—14, 14—18, 18—5), (14—19, 19—9, 9—22), (6—12, 12—15, 15—13, 13—25), (17—21). The



FOUR IN LINE

counters are now all correctly arranged | in 19 exchanges. The numbers within a pair of brackets represent a complete cycle, all being put in their proper places. Write out the numbers in their original order, and beneath them in their required order, thus :

7	24	10	19	3	12	20	8	22, etc.
1	2	3	4	5	6	7	8	9, etc.

Then the construction of the cycles is obvious, for 1 in the bottom row is exchanged with the 7 above it, then this 7 with the 20 above it, and so on until the cycle completes itself, when we come to 24 under 1.

251.—NINE MEN IN A TRENCH

LET the men move in the following order : 2—1, 3—2, 4—3, 5—11, 6—4, 7—5, 8—6, 9—7, 1—13, 9—10, 8—9, 1—12, 7—13, 6—8, 5—7, 1—11, 4—12, 3—6, 2—5, 1—1, 2—2, 3—3, 4—4, 5—5, 6—6, 7—7, 8—8, 9—9, and the sergeant is in his place in 28 moves. The first number in a move is that of a man, and the second number that of his new position, the places being numbered 1 to 10 in the row, and the recesses 11 to 13 above.

252.—BLACK AND WHITE

IN the first case move the pairs in the following order: 6 7 before the 1, then 3 4, 7 1, and 4 8 to the vacant spaces, leaving the order 6 4 8 2 7 1 5 3.

IN the second case move 3 4 and replace them as 4 3 before the 1. Then remove and reverse 6 7, 6 5 (as 5 6), 3 1 (as 1 3), and 6 8 (as 8 6), leaving the order 4 8 6 2 7 1 3 5—five moves in this case.

253.—THE ANGELICA PUZZLE

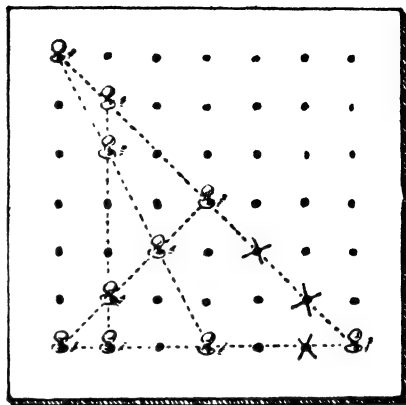
THOUGH we start with the A's in correct positions, the puzzle can only be solved by making them change places. Represent the A in the bottom row with a capital letter, and the A in the top corner with a small letter. Then here is a solution in 36 moves: A N L E G A N G C I A N G C I A N G C L E a A N G I L C I L a E C a L I (36 moves).

254.—THE FLANDERS WHEEL

MOVE the counters in the following order: A N D A F L N D A F D N L D R S D L N A F R S E R S L N A L L—30 moves in all.

255.—A PEG PUZZLE

THE diagram shows how to place the pegs. The three removed from the holes bearing a cross are replaced in the top left-hand corner. The ten pegs now form five rows with four pegs in every row. If you reflect the diagram in a mirror you will get the only other solution.



256.—CATCHING THE PRISONERS

IT is impossible for W 1 (warder) to catch P 2 (prisoner), or for W 2 to catch P 1. In the example we gave it was therefore hopeless, for each warder would not be chasing "his prisoner," but the other fellow's prisoner. It is a case of what we call in chess "gaining the opposition."

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
(P ₁) ¹⁷	18	(W ₁) ¹⁹	20	21	(W ₂) ²²	23	(P ₂) ²⁴
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40

BETWEEN W 1 and P 2 there is only one square (an odd number), but between W 1 and P 1 (as also between W 2 and P 2) there are four squares (an even number). In the second case the warders have the opposition, and can win. We will give a specimen game. The war-

ders' moves are above the line, the prisoners' below :

$\frac{19-20 \ 22-14, \ 20-21 \ 14-13, \ 21-22 \ 13-12,}{17-18 \ 24-23, \ 18-26 \ 23-31, \ 26-27 \ 31-32}$

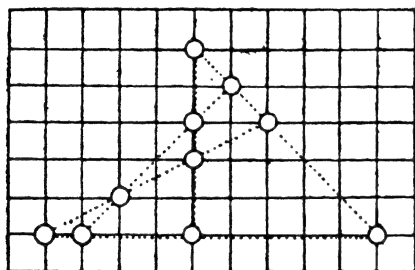
$\frac{22-23 \ 12-20, \ 23-31 \ 20-19,}{27-26 \ 32-40, \ 40-32 \ 26-34}$

$\frac{31-32 \text{ Capture, } 19-27}{34-33}$

$\frac{27-26, \ 26-25 \text{ Capture.}}{33-25}$

There is no possible escape for the prisoners if each warder pursues his proper man.

257.—FIVE LINES OF FOUR



THE illustration shows the solution to this puzzle. The ten counters form five rows with four counters in every row.

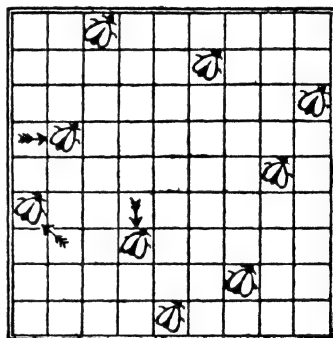
258.—DEPLOYING BATTLESHIPS



THE illustration shows that the ships form five lines with four in every line, and the white phantom ships indicate the positions from which four of them have been removed.

259.—FLIES ON WINDOW PANES

positions, as indicated by the arrows,



and still no two flies are in a straight line.

260.—STEPPING-STONES

NUMBER the stepping-stones 1 to 8 in regular order. Then proceed as follows : 1 (bank), 1, 2, 3, (2), 3, 4, 5, (4), 5, 6, 7, (6), 7, 8, bank, (8), bank. The steps in brackets are taken in a backward direction. It will thus be seen that by returning to the bank after the first step, and then always going three steps forward for one step backward, we perform the required feat in nineteen steps.

261.—THE TWENTY-TWO BRIDGES

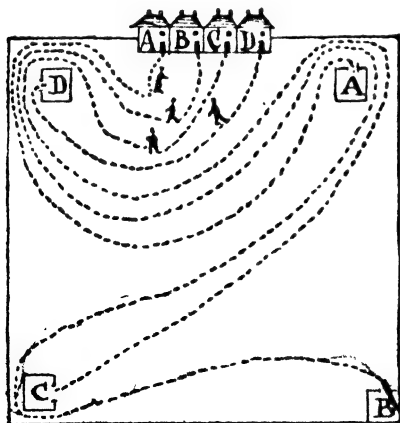
It will be found that every department has an even number (2, 4, or 6) of bridges

leading from it, except C and L, which can be approached each by three bridges—an odd number. Therefore to go over every bridge once, and only once, it is necessary to begin and end at C and L, which are the two departments in which the houses stand. Thus, starting from C, we may take the following route: C, G, F, C, B, A, D, H, E, I, H, J, K, L, M, G, I, F, B, E, F, I, L.

262.—A MONMOUTH TOMBSTONE

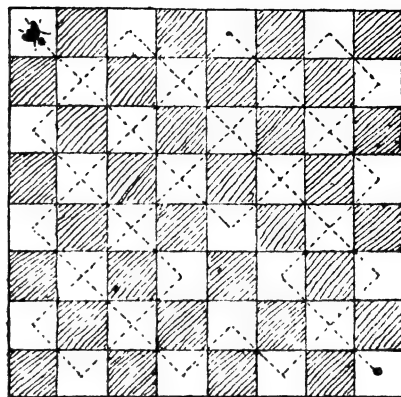
THE number of different ways in which "HERE LIES JOHN RENIE" can be read is 45,760; or, if diagonal readings are allowed, 91,520, because on reaching one of the corner I's we have the option of ending in the extreme corner or going backwards to an E diagonally. There is not space to give the working in detail. The only other information on the stone is "who died May 31, 1832, aged 32 years."

263.—FOOTPRINTS IN THE SNOW



THE illustration explains itself.
(8.646)

264.—THE FLY'S TOUR



THE line here shows the fly's route under th

265.—INSPECTING THE ROADS

THE shortest possible route is as follows :
 ABCHCDEIEFGBBHDIHGIFAG.
 Thus he has gone 211 miles, and passed
 along the two short roads CH and EI
 twice.

266.—RAILWAY ROUTES

THERE are 2,501 ways of going, as follows :

1-station journey .	1 route .	2 variations	2
2-station	" . 1	" . 9	9
3-station	" . 2 routes .	12	24
4-station	" . 5	" . 18	90
5-station	" . 4	" . 72	288
6-station	" . 14	" . 36	504
8-station	" . 22	" . 72	1,584
			2,501

We have only to consider the routes from B to D. The 1-station route is direct to D. The 2-station route is CD. The two 3-station routes are CBD and

D C D. The five 4-station routes are D B C D, D C B D, C B C D, C D C D, and C D B D. Each of these routes is subject to a number of variations in the actual lines used, and for a journey of a given number of stations there is always the same number of variations, whatever the actual route. A 7-station journey is not possible.

267.—A MOTOR-CAR TOUR

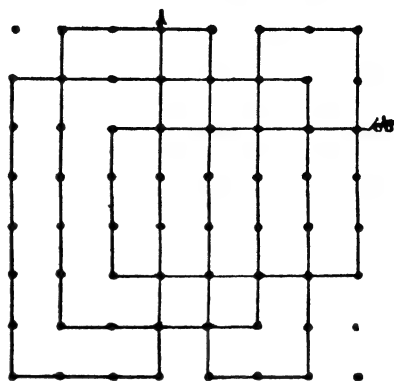
THE number of different routes is 264. It is quite a difficult puzzle, and consideration of space does not admit of my showing the best method of making the count.

268.—MRS. SIMPER'S HOLIDAY TOUR

THERE are just sixty different routes by which Mrs. Simper, starting from H, might visit every one of the towns once, and once only, by the roads shown, and return to H, counting reversals of routes as different. But if the lady is to avoid going through the tunnels between N and O, and S and R, it will be found that she is restricted to eight different routes.

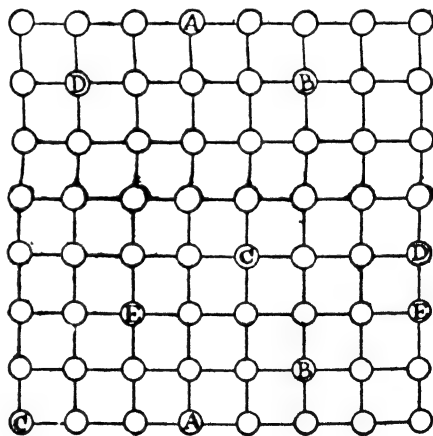
If the reader is sufficiently interested he may like to discover these eight routes for himself. If he does so, he will find that the route that complies with the conditions, avoids the two tunnels, and delays her visit to D as long as possible, is as follows: HISTLKBCMN UQR GFPODEAH. This is, therefore, undoubtedly her best route.

269.—SIXTEEN STRAIGHT RUNS



THE illustration shows how the traveller could have driven his motor-car 76 miles in sixteen straight runs and left only three towns unvisited. This is not an easy puzzle, and the solution is only to be found after considerable trial.

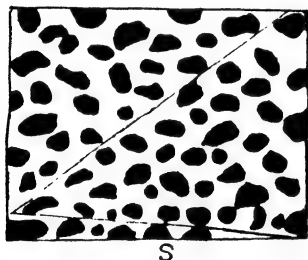
270.—PLANNING TOURS



IN our illustration, in which the roads not used are omitted for the sake of clearness, every man's route is shown. It will be seen that no two drivers ever

go along the same road, and that no man ever crosses the track of another. Although no hard-and-fast rules can be laid down for the solution of puzzles in this particular class, a little careful thought will generally overcome our difficulties. For example, we showed in the puzzle that if A goes direct to A in a straight line, we shall hopelessly cut off C, D, and E. It soon becomes evident that A must go to the left of the upper D, and having done so, must then get to the right of C. Also the route from D to D then becomes evident, as does that from B to B, and the rest is

271.—AVOIDING THE MINES



THE illustration shows the passage through the mines in two straight courses.

272.—A MADAM PROBLEM

EVERY reading must begin with an M, and as there are only four M's there can only be four starting-points. It will be found that there are 20 different ways of reading MADAM, always starting from the same M, therefore the correct answer is that there are 80 ways in all.

273.—CITY LUNCHEONS

If the Pilkins staff had been 11 in number, and the Radson staff 12, they could have sat down differently in 165 and 495 ways respectively, which would have solved the question. Only we were told that there happened to be the same number of men in each staff. Therefore the answer is 15 in threes for 455 days, and 15 in fours for 1,365 days.

274.—HALFPENNIES AND TRAY

WE have received from Dr. G. T. Bennett a solution in sixty-four coins, also one by his niece. The secret lies in starting with a large outer circle of twenty-five coins and working to the centre. Only you must be careful that the central coin does not touch all the six that surround it.

275.—THE NECKLACE PROBLEM

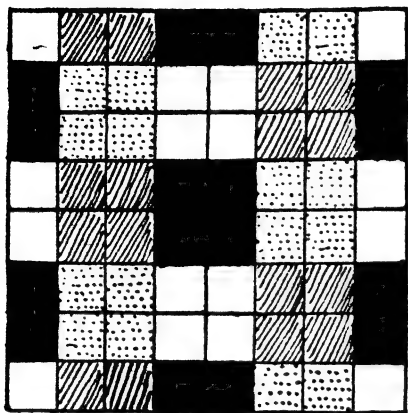
THE number of different necklaces with eight beads under the conditions is 30.

A general solution for any number of beads is difficult, if not impossible. But with as few as eight beads the reader will have no difficulty in finding the correct answer by mere trial.

276.—AN EFFERVESCENT PUZZLE

THE answer to the first case is 88,200 ways. There is an easy way of getting the answer, but it would require too much space to explain it in detail. In the second case the answer is reduced to 6,300 ways.

277.—TESSELLATED TILES



DISCARD the first tile in each of the four horizontal rows. Then the remaining sixteen may be arranged as shown in the illustration, in accordance with the conditions.

278.—THIRTY-SIX LETTER PUZZLE

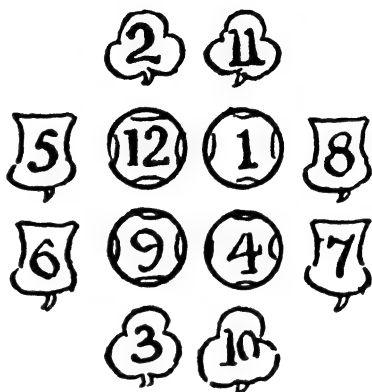
IF you have tried, as most people do, first to place all six of one letter, then all six of another letter, and so on, you will find, after you have placed four

<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F</u>	<u>A</u>	<u>B</u>
	<u>F</u>	<u>E</u>					<u>B</u>
			<u>D</u>	<u>B</u>		<u>F</u>	
						<u>D</u>	
			<u>C</u>				
							<u>D</u>
<u>E</u>	<u>D</u>	<u>C</u>	<u>B</u>			<u>A</u>	<u>B</u>

different kinds of letters six times each, it is impossible to place more than two letters each of the last two letters, and you will get our arrangement No. 1. The secret is to place six of each of two

letters, and five of each of the remaining four, when we get our second diagram, with only four blanks.

279.—ROSES, SHAMROCKS, AND THISTLES



It is clear that the sum obtained in the different ways must be 26. Here is one of many arrangements that solve the puzzle.

280.—THE TEN BARRELS

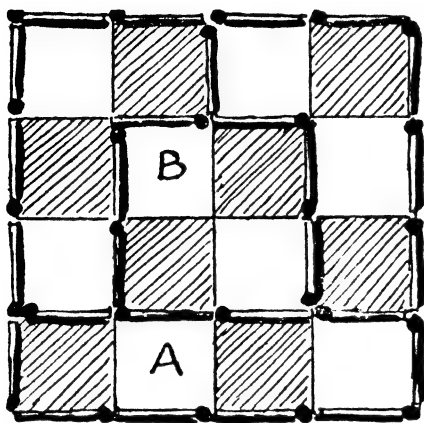
ARRANGE the barrels in one of the following two ways, and the sides will add up 13 in every case—the smallest number possible :

		0				0	
	8	6			7	8	
4	9	5		5	9	3	
1	7	3	2	1	6	4	2

By changing the positions of the side numbers (without altering the numbers contained in any side) we get eight solutions in each case, not counting mere reversals and reflections as different.

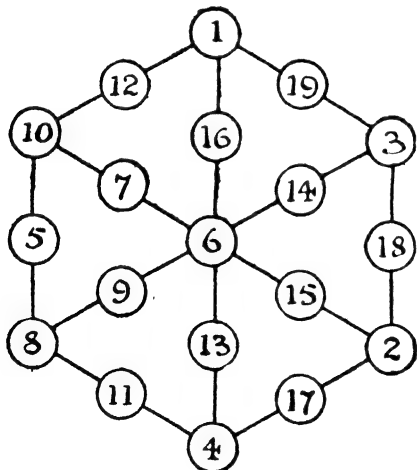
SOLUTIONS

281.—A MATCH PUZZLE



THE illustration shows one of the four distinctive ways of solving this puzzle, with eleven, an *odd* number of matches. If you first enclose an outside row, as A, then you can enclose the square, B, in any position, and complete the solution with eleven matches in all.

282.—THE MAGIC HEXAGON



OUR illustration shows the only correct answer.

283.—PAT IN AFRICA

PAT said, "Begorra, one number's as good as another and a little better, so, as there are ten of us and myself, sure I'll take eleven, and it's myself that I'll begin the count at." Of course, the first count fell on himself. Eleven, starting at No. 1, is thus the smallest number to count out all the Britishers. He was, in fact, told to count twenty-nine and begin at No. 9. This would have counted out all the natives. These are the smallest numbers.

284.—LAMP SIGNALLING

WITH 3 red, white, or green lamps we can make 15 variations each (45). With 1 red and 2 white we can make the same, 15, and each way will admit of 3 variations of colour order, 45 in all. The same with 1 red and 2 green, 1 white and 2 red, 1 white and 2 green, 1 green and 2 white, 1 green and 2 red (270). With 1 red, 1 white, and 1 green we can get 6 by 15 variations (90). With 2 red or 2 white or 2 green we can get 7 patterns (21). With 1 red and 1 white, or 1 red and 1 green, or 1 white and 1 green, we can get 14 variations each (42). With 1 lamp only we can get only 1 signal each (3). Add together the numbers in brackets (45, 270, 90, 21, 42, and 3), and we get the answer, 471 ways.

285.—THE TEASHOP CHECK

THE amount of one customer's bill must have been 7*d.*, and the other's 3*s.* the total of prices printed being 3*s.* The 7*d.* can be punched in ten different

ways *and no more*. In every case the prices left unpunched will indicate those to be punched to register the price, 3s. 4½d., which simple fact accounts for the second waitress's prompt reply.

286.—UNLUCKY BREAKDOWNS

THERE must have been 900 persons in all. One hundred wagons started off with nine persons in each wagon. After 10 wagons had broken down, there would be ten persons in every wagon—"one more." As 15 more wagons had to be withdrawn on the home journey, each of the remaining 75 wagons would carry twelve persons—"three more than when they started out in the morning."

287.—HANDCUFFED PRISONERS

THE following is a solution. Every prisoner will be found to have been handcuffed to every other prisoner once, and only once.

1-2-3 2-6-8 6-1-7 1-4-8 7-2-9 4-3-1
4-5-6 5-9-1 9-4-2 2-5-7 3-6-4 5-8-2
7-8-9 3-7-4 8-3-5 6-9-3 8-1-5 9-7-6

If the reader wants a hard puzzle to keep him engrossed during the winter months, let him try to arrange twenty-one prisoners so that they can all walk out, similarly handcuffed in triplets, on fifteen days without any two men being handcuffed together more than once.

In case he should come to the opinion that the task is impossible, we will add that we have written out a perfect solution. But it is a hard nut!

288.—SEATING THE PARTY

THE number of different ways in which the six occupants of the car can be seated under the conditions is 144.

289.—MAGIC SQUARE TRICK

THOUGH the figures in each cell must be different in every case, it is not required that the *numbers* shall be different. In our smaller square the rows of cells add

$$4\frac{1}{2}$$

$$10$$

$$6+6$$

$$3-3$$

$$\begin{array}{r} 4 \\ 4+4 \end{array}$$

to 15 in ten different directions, for in addition to the rows, columns, and two long diagonals, two of the short diagonals also add to 15. This is the greatest

number of directions possible. Now, all we have to do is to express each number with a different figure by repeating it with arithmetical signs. The larger square shows how this may be done. All the conditions of the puzzle are thus complied with, and the maximum ten directions obtained.

290.—A FOUR-FIGURE MAGIC SQUARE

THE solution explains itself. The columns, rows, and two diagonals all add

2243 1341 3142

3141 2242 1343

3143 2241

up alike to 6,726, and nine of each of the figures 1, 2, 3, 4 have been employed.

291.—PROGRESSIVE SQUARES

FILL in the following numbers in the order given, beginning at the cell in the top right-hand corner and proceeding downwards and "round the square": 13, 81, 78, 6, 75, 8, 15, 16, 77, 70, 19, 79, 21, 9, 23, 2, 69, 66, 67, 74, 7, 76, 4, 1, 5, 80, 59, 73, 61, 3, 63, 12. Of course it was obvious that opposite numbers in the border must sum to 82 in all cases, but a correct adjustment of them is not

very easy. Of course there are other solutions.

292.—CONDITIONAL MAGIC SQUARE

18 22 10

7 11

6 19

16

THE example here shown is a solution, with the odd numbers and even numbers placed in the positions desired.

293.—THE TWENTY PENNIES

ARRANGE the sixteen pennies in the form of a square 4 by 4. Then place one penny on top of the first one in the first row; one on the third in the second row; one on the fourth in the third row; and one on the second in the fourth row.

294.—THE KEG OF WINE

THE capacity of the jug must have been a little less than 3 gallons. To be more exact, it was 2.93 gallons.

295.—BLENDING THE TEAS

THE grocer must mix 70 lb. of the 2s. 8d. tea with 30 lb. of the 3s. 4d. tea.

296.—WATER MEASUREMENT

Two pints may be measured in fourteen transactions as below, where the vessels above the line are empty and every other row shows a transaction.

	II
7	0
0	7
7	7
3	II
3	0
0	3
7	3
0	10
7	10
6	II
6	0
0	6
7	6
2	II

The contents of the vessels, after each transaction, will make everything clear.

297.—MIXING THE WINE

THE mixture will contain $\frac{7}{14}$ wine, and $\frac{1}{14}$ water.

298.—THE STOLEN BALSAM

ONE of several solutions is as follows :

	oz.	oz.	oz.	oz.
The vessels can hold . . .	24	13	11	5
Their contents at the start	24	0	0	0
Make their contents . . .	0	8	11	5
Then	16	8	0	0
Then	16	0	8	0
Then	3	13	8	0
Then	3	8	8	5
Finally	8	8	8	0

299.—THE WEIGHT OF THE

THE fish must have weighed 72 oz. or $4\frac{1}{2}$ lb. The tail weighed 9 oz., the body 36 oz., and the head 27 oz.

300.—FRESH FRUITS

SINCE the lower scales tell us that one apple and six plums equal in weight one pear, we can substitute one apple and six plums for the pear in the upper scales without disturbing the balance. Then we can remove six plums from each pan in the upper scales, and find that four apples equal four plums. Consequently one apple equals one plum, and if we substitute a plum for the apple in the lower scales, as they originally stood, we see that seven plums equal one pear in weight. So the old book says Q.E.D. (quite easily done !)

301.—WEIGHING THE TEA

(1) WITH the 5 lb. and 9 lb. weights in different pans weigh 4 lb. (2) With the 4 lb. weigh second 4 lb. (3) Weigh third 4 lb. (4) Weigh fourth 4 lb., and the remainder will also be 4 lb. (5), (6), (7), (8), (9) Divide each portion of 4 lb. in turn equally on the two sides of the scales.

302.—DELIVERING THE MILK

THE simplest way of showing the solution is as follows : At the top we have four vessels, in the second line their contents at the start, and in every sub-

sequent line the contents after a trans-
action :

80-pint can.	80-pint can.	5-pint jug.	4-pint jug.
80	80	0	0
75	80	5	0
75	80	1	4
79	80	1	0
79	80	0	1
74	80	5	1
74	80	2	4
78	80	2	0
78	76	2	4
80	76	2	2

Thus we first fill the 5-pint jug from one of the cans, then fill the 4-pint jug from the 5-pint, then empty the 4-pint back into the can, and so on. It can be followed quite easily this way. Note the ingenuity of the last two trans- actions—filling the 4-pint jug from the second can and then filling up the first can to the brim.

303.—CROSSING THE RIVER

THE two children row to the opposite shore. One gets out and the other brings the boat back. One soldier rows across; soldier gets out, and boy returns with boat. Thus it takes four crossings to get one man across and the boat brought back. Hence it takes four times 358, or 1,432 journeys, to get the officer and his 357 men across the river and the children left in joint possession of their boat.

304.—GRASSHOPPERS' QUADRILLE

It is quite easy when once you grasp the situation. If we regard only the central
(8,646)

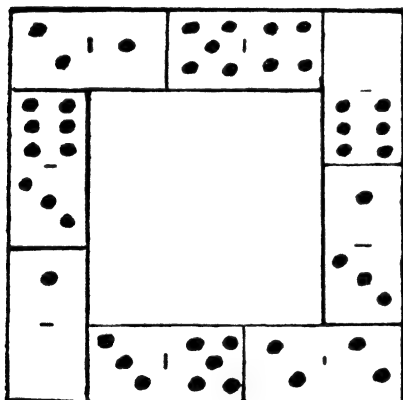
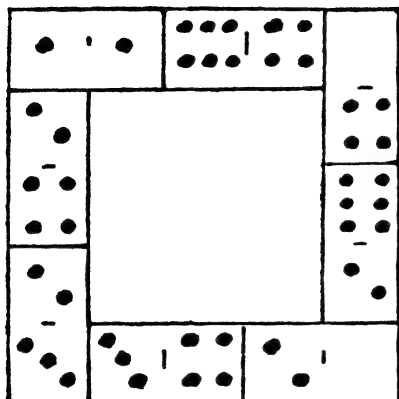
column containing three white and three black draughts, these can be made to change places in fifteen moves. Number the seven squares downwards 1 to 7. Now play 3 to 4, 5 to 3, 6 to 5, 4 to 6, 2 to 4, 1 to 2, 3 to 1, 5 to 3, 7 to 5, 6 to 7, 4 to 6, 2 to 4, 3 to 2, 5 to 3, 4 to 5. Six of these moves are simple moves, and nine are leaps. Now, there are seven horizontal rows of three white and three black draughts, if we exclude that central column. Each of these rows may be similarly interchanged in fifteen moves, and as there is some opportunity of doing this in every case while we are manipulating the column—that is to say, there is always, at some time or other, a vacant space in the centre of every row—it should be obvious that all the draughts may be interchanged in $8 \times 15 = 120$ moves.

305.—DOMINO FRAMES

THE three diagrams show a solution. The sum of all the pips is 132. One-third of this is 44. First divide the



dominoes into any three groups of 44 pips each. Then, if we decide to try 12



for the sum of the sides, 4 times 12 being 4 more than 44, we must arrange in every case that the four corners in a frame shall sum to 4. The rest is done by trial and exchanges from one group to another of dominoes containing an equal number of pips.

306.—A PUZZLE IN BILLIARDS

It is clear that A can score 100 while B makes 79; and that B can make 100

while C scores 74. Multiply 79 by 74, double, and divide by 100, and we get 116.92; so C can score 117 (as there are no fractional points), while A makes 200. Therefore A can give C 82 points and win. Some would make the answer 83, and the difference depends on what view you take of that fraction. We can say with certainty that at least 82 points can be safely given.

307.—SCORING AT BILLIARDS

THE highest score in two consecutive shots is 18.

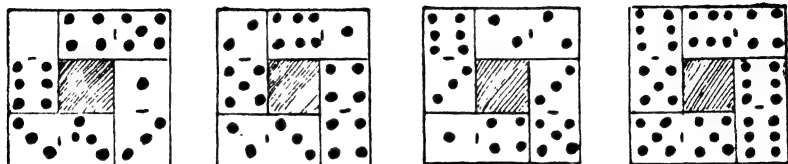
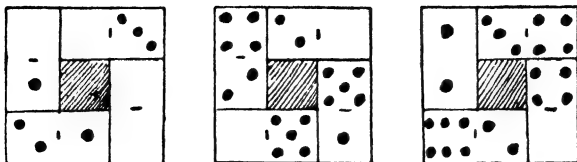
Many will give the answer as 16.

1. Cannon (2), pot the white (2), pot the red (3), and in-off red (3)—making 10. 2. Pot the red (3), and in-off red (3)—making 6. Total for two shots, 16.

But the first shot should leave the white up, scoring 8 only, after which the 10 shot can be made. Total, 18.

308.—DOMINO HOLLOW SQUARES

It is shown in the illustration how the 28 dominoes may be arranged in the form of seven hollow squares, so that the pips in the four sides of every square add up alike. It is well to remember this little rule when forming your squares. If the pips on your dominoes sum, say, to 7 (as in the first example), and you wish the sides to add up 3, then $4 \times 3 - 7$ gives us 5 as the sum of the four corners. This is absolutely necessary. Thus, in the last example, $4 \times 16 = 64 - 43$ tells us that the four corners must sum to 21, as it will be found they do.



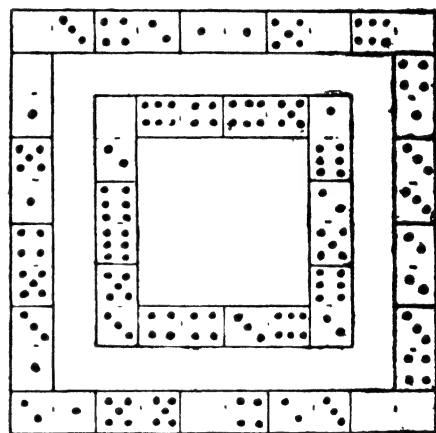
DOMINO HOLLOW SQUARES

309.—DOMINO SEQUENCES

IF we draw from the set the four dominoes 7—6, 5—4, 3—2, 1—0, the remaining dominoes may be put together in proper sequence. Any other combinations of these particular numbers would do equally well; thus we might withdraw 7—0, 6—1, 5—2, and 4—3. Generally, for any set of dominoes ending in a double odd number, those withdrawn must contain together every number once from blank up to two less than the highest number in the set.

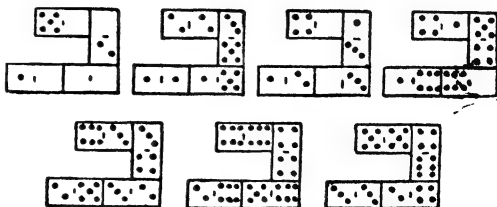
310.—TWO DOMINO SQUARES

THE illustration shows how the twenty-eight dominoes may be laid out so as to form the two required squares with the pips in each of the eight sides summing to 22. With a blank in every corner the sides must sum to 21, with 22 the corners must sum to 8, with 23 to 16, with 24 to 24, with 25 to 32, with 26 to 40. Thus the constant sum cannot be less than 21 nor more than



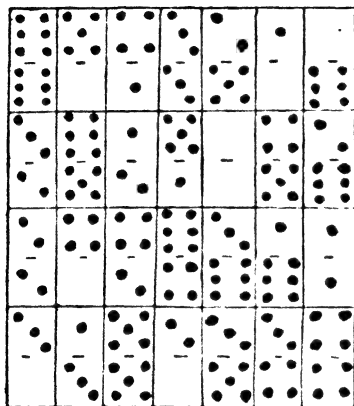
26, because with 27 we shall require 48 in the corners, and more than 47 is not possible.

311.—DOMINO MULTIPLICATION



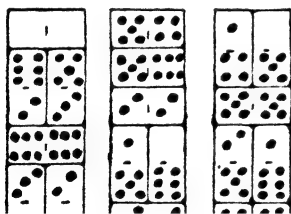
HERE all the twenty-eight dominoes are used, and they form seven multiplication sums as required.

312.—DOMINO RECTANGLE



THE illustration shows how the twenty-eight dominoes may be arranged so that the columns add up 24 and the rows 21.

313.—THE DOMINO COLUMN



PLACE the second column under the first, and the third under the second (the column is broken merely for convenience

in printing), and the conditions will be found to be fulfilled.

314.—CARD SHUFFLING

To shuffle fourteen cards in the manner described, so that the cards shall return to their original order, requires fourteen shuffles, though with sixteen cards we require only 5. We cannot go into the law of the thing, but the reader will find it a very interesting investigation.

315.—ARRANGING THE DOMINOES

THERE are just 126,720 different ways of playing those 15 dominoes, counting the two directions as different.

316.—QUEER GOLF

THE two best distances are 100 yards (called "the approach"), and 125 yards ("the drive"). Hole 1 can be reached in three approaches, hole 2 in two drives, hole 3 in two approaches, hole 4 in two approaches and one drive, hole 5 in three drives and one backward approach, hole 6 in two drives and one approach, hole 7 in one drive and one approach, hole 8 in three drives, and hole 9 in four approaches—26 strokes in all.

317.—THE ARCHERY MATCH

MRS. FINCH scored 100 with four 17's and two 16's; Reggie Watson scored 110 with two 23's and four 16's; Miss Dora Talbot scored 120 with one 40 and five 16's. Her score can be made up in various ways, except for the fact that

the bull's-eye has to be got in some- | eight added together correctly make
where, and this is the only place where | nineteen.
it can occur.

318.—TARGET PRACTICE

THE total score was 213, so each man scored 71, and this could be done in the following manner: One man scored 50, 10, 5, 3, 2, and 1; another scored 25, 20, 20, 3, 2, and 1; and the third man 25, 20, 10, 10, 5, and 1.

319.—THE TEN CARDS

THE first player can always win. He must turn down the third card from one of the ends, leaving them thus: 00.000000. Now, whatever the second player does, the first can always leave either 000.000 or 00.00.0.0 or 0.00.000 (order of groups does not matter). In the first case, whatever the second player does in one triplet the other repeats in the other triplet, until he gets the last card. In the second case, the first player similarly repeats the play of his opponent, and wins. In the third case, whatever the second player does, the first can always leave either 0.0, or 0.0.0.0, or 00.00, and again get an obvious win.

320.—AN AWKWARD TIME

THE Colonel's friend said that 12.50 is clearly an awkward time for a train to start, because it is ten to one (10 to 1) if you catch it.

321.—CRYPTIC ADDITION

IF you turn the page upside down you will find that one, nine, one, and

322.—THE NEW GUN

THE gun should have fired the 15 shots in 14 minutes. Mark 15 dots in a line, 1 in. apart, and you will at once see that the distance from the first dot to the last dot is 14 in.—not 15. The answer is therefore not "Because the Swiss have no navy," for the Government wanted the gun for other purposes.

323.—CATS AND MICE

IT is clear that 999,919 cannot be a prime number, and that if there is to be only one answer it can have only two factors. As a matter of fact these are 991 and 1,009, both of which are primes, and as each cat killed more mice than there were cats, the correct answer is clearly that 991 cats each killed 1,009 mice.

324.—THE TWO SNAKES

WE cannot say how much of each snake must be swallowed before a vital organ is sufficiently affected to cause death. But we can say what will *not* happen—that the snakes will go on swallowing one another until both disappear altogether! But where it will really end it is impossible to say.

325.—THE PRICE OF A GARDEN

THE measurements given are absurd, and will not form a triangle. To do so the two shorter sides must together be

greater than the third. The Professor gave it to his pupils just to test their alertness.

326.—STRANGE THOUGH TRUE

If the horse is put in a chaff-cutter, or any mill in which he travels in a circle in a clockwise direction, the near legs pass over more ground than the off legs, since they make a larger circle. This applies not only to Sussex, but to anywhere.

327.—TWO PARADOXES

If W. and E. were stationary points, and W., as at present, on your left when advancing towards N., then, after passing the Pole and turning round, W. would be on your right, as stated. But W. and E. are not fixed points, but *directions* round the globe; so wherever you stand facing N., you will have the W. direction on your left and the E. direction on the right.

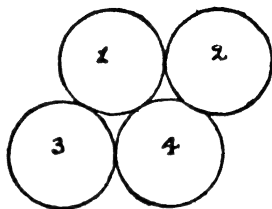
In the reflection in a mirror you are not "turned round," for what appears to be your right hand is your left, and what appears to be your left side is the right. The reflection sends back, so to speak, exactly what is opposite to it at every point.

328.—CHOOSING A SITE

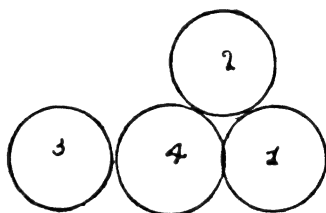
This was a little jest. He may build wherever he pleases, for if perpendiculars are drawn to the sides of an equilateral triangle from *any* point in the triangle, their united length will be equal to the altitude of the triangle.

329.—THE FOUR PENNIES

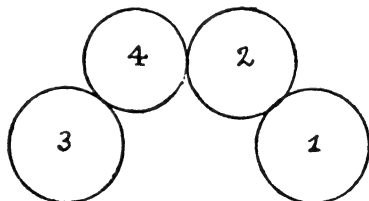
FIRST place the four pennies together, as in the first diagram; then remove No. 1 to the new position shown in the



second diagram; and finally, carefully withdraw No. 4 downwards and replace it above against Nos. 2 and 3. Then



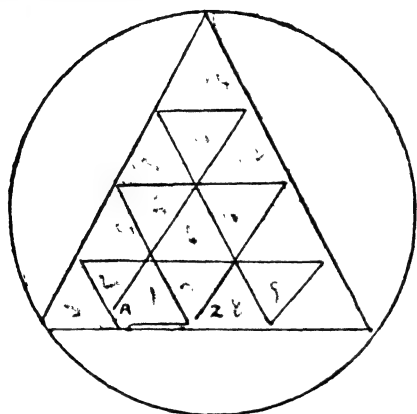
they will be in the position shown in the third diagram, and the fifth penny may be added so that it will exactly touch



all four. A glance at the last diagram will show how difficult it is to judge by the eye alone the correct distance from No. 1 to No. 3. One is almost certain to place them too near together.

330.—THE ENCIRCLED TRIANGLES

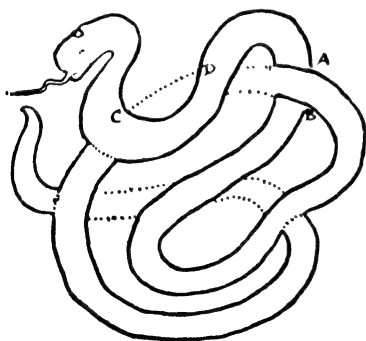
THIS puzzle may be solved in the astonishingly small number of fourteen



strokes, starting from A and ending at Z. Places in the figure are purposely not joined up, in order to make the route perfectly clear.

331.—THE SIAMESE SERPENT

THE drawing cannot be executed under the conditions in fewer than thirteen

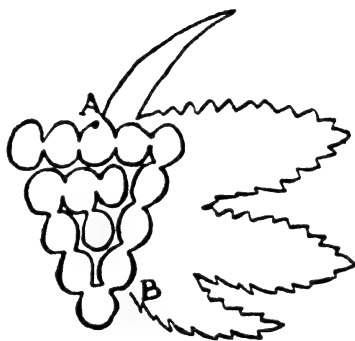


lines. We have therefore to find the longest of these thirteen lines. In the illustration we start at A and end at B,

or the reverse. The dotted lines represent the lines omitted. It requires a little thought. Thus, the line from D to C is longer than the dotted line, therefore we take the former. Again, we can get in a little more of the drawing by taking the tongue rather than the mouth, but the part of the tongue that ends in a straight line has to be omitted.

332.—A BUNCH OF GRAPES

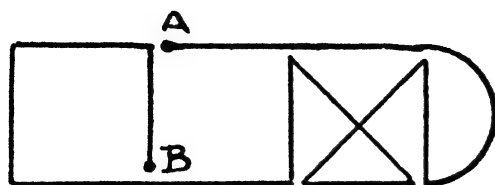
THERE are various routes possible, and our illustration shows one of them. But it is absolutely necessary that you begin at A and end at B, or the reverse. At



any other point in the drawing a departure can be made in two or four ways (even numbers), but at A and B there are three ways of going (an odd number), therefore the rule is that you must begin and end at A and B.

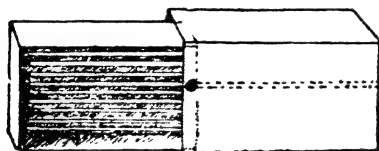
333.—A HOPSCOTCH PUZZLE

THE hopscotch puzzle may be drawn in one continuous line without taking the pencil off the paper, or going over the



same line twice. But it is necessary to begin at the point A and end at B, or begin at B and end at A. It cannot otherwise be done.

334.—A LITTLE MATCH TRICK

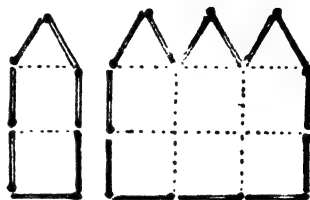


You must secrete the match inside in the manner shown by the dotted lines in the illustration, so that the head is just over the edge of the tray of the box. In closing the box you press this extra match forward with the thumb-nail (which, if done carefully, will not be noticed), and it falls into its place. Of course, one of the matches first shown does not turn round, as that would be an impossibility, but nobody ever counts the matches.

335.—THREE TIMES THE SIZE

THE illustration shows how two enclosures may be formed with 13 and 7 matches respectively, so that one area shall be exactly three times as large as the other. The dotted lines will show that one figure contains two squares and

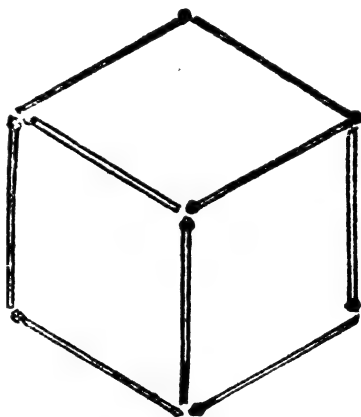
an equilateral triangle, and the other six squares and three such



triangles. The 12 horizontal and vertical matches have not been moved.

336.—A SIX-SIDED FIGURE

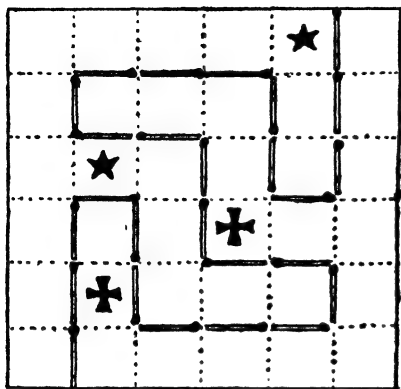
THE illustration shows the simple answer. We did not ask for a *plane* figure,



nor for the figure to be *formed* with the 9 matches. We show (in perspective) a *cube* (a regular six-sided figure).

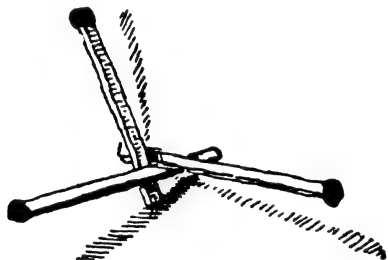
337.—TWENTY-SIX MATCHES

THE illustration shows how the 26 matches may be placed so that the square is divided into two parts of exactly the same size and shape, one



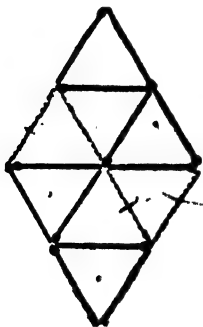
part containing two stars, and the other two crosses.

338.—THE THREE MATCHES



ARRANGE the three matches as shown in the illustration, and stand the box on end in the centre.

339.—EQUILATERAL TRIANGLES



REMOVE the four matches indicated by the dotted lines, and the remainder form four equal triangles.

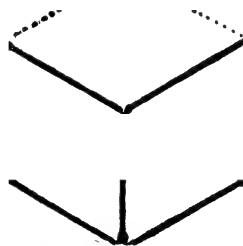
340.—SQUARES WITH MATCHES

IN the illustration the dotted lines indicate the six matches that have been



removed. The thin lines show where they are replaced, and the thick lines indicate the six that have not been moved.

341.—HEXAGON TO DIAMONDS

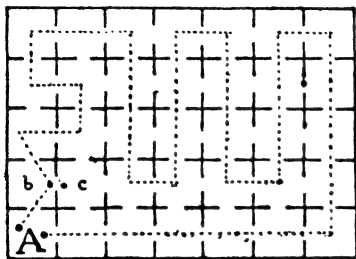


THE illustration will show by the dotted lines the original position of the two matches that have been moved.

342.—A WILY PUZZLE

IN the diagram it will be seen that the prisoner's course is undoubtedly all

right until we get to B. If we had been the prisoner, when we got to that point we should have placed one foot at C, in the neighbouring cell, and have said, "As one foot has been in cell C we have



undoubtedly entered it, and yet when we withdraw that foot into B we do not enter B a second time, for the simple reason that we have never left it since we first went in!"

343.—"TOM TIDDLER'S GROUND" WINNERS

THE large majority of competitors who tried to solve Mr. Dudeney's puzzle, "Tom Tiddler's Ground," in the *Daily News*, succeeded in securing bags containing only £45.

The correct answer is £47 contained in ten bags, all deposited on outside plots, thus: 4, 5, 6 in the first row, 5 in the second, 4 in the third, 3 in the fourth, 5 in the fifth, and 5, 6, 4 in the bottom row. If you include five bags containing £6 each, you can secure only nine bags, and a value of £46.

344.—COIN AND HOLE

STRANGE though it may at first appear, the half-crown may be passed through



that small hole (of the size of a six-pence) without tearing the paper. This is the largest coin that can be used. First fold the paper across the centre of the hole and drop the coin into the fold. Then, holding the paper at A and B, bring the hands together upwards, and the coin may be shaken through the hole.

345.—THE EGG CABINET

SAY the number of drawers is n . Then there will be $2n - 1$ strips one way and $2n - 3$ strips the other, resulting in $4n^2 - 4n$ cells and $4n - 4$ strips. Thus, in the twelfth drawer we shall get 23 and 21 strips (44 together), and 528 cells. This applies to all drawers except the second, where we may have any number of strips one way, and a single one the other. So 1 and 1 will here serve (a single strip is not admissible, because "intersecting" was stipulated). There are thus only 262 strips in all, and 2,284 cells (not 264).

346.—A LEAP YEAR

SINCE the new style was adopted in England in 1752, the first year with Wednesdays
Then 1792 and 1804. By adding 28, we then get 1832, 1860, 1888. Then we make the jump to 1928, 1956, 1984,

and 2012. The answer is, therefore, 1888 and 1956. Normally it occurs every twenty-eighth year, except that 1800 and 1900 (which were not leap years) come in between, when the rule breaks down. As 2000 will be a leap year, twenty-eight years from 1984 is correctly 2012.

347.—THE IRON CHAIN

THE inner width of a link, multiplied by the number of links, and added to twice the thickness of the iron, gives the exact length. Every link put on the chain loses a length equal to twice the thickness of the iron. The inner width must have been $2\frac{1}{2}$ in. This, multiplied by 9 and added to 1 makes 22 in., and multiplied by 15 and added to 1 makes 36 in. The two pieces of chain, therefore, contained 9 and 15 links respectively.

348.—BLOWING OUT THE CANDLE

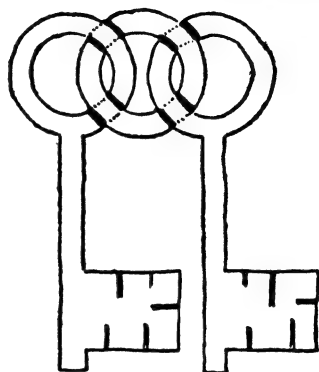
THE trick is to lower the funnel until the dotted line, C A, on the top in the puzzle illustration, is in line with the flame of the candle. Any attempt to blow the candle out with the flame opposite the centre of the opening of the funnel is hopeless.

349.—RELEASING THE STICK

IF you take the loop and pull through it as much of the coat above and below the buttonhole as is necessary, it will be possible to pass the lower end of the stick through the buttonhole and get it in the required position. To disentangle it you reverse the process, though it is rather more perplexing. If you put it

on your friend's coat carefully while he is not looking, it will puzzle him to remove it without cutting the string.

350.—THE KEYS AND RING



FIRST cut out the keys and ring in one piece, as here shown. Now cut only half through the cardboard along the eight little dark lines, and similarly cut half through on the eight little dotted lines *on the other side of the cardboard*. Then insert a penknife and split the card below the four little squares formed by these lines, and the three pieces will come apart with the keys loose on the ring and no join.

351.—THE ENTANGLED SCISSORS

SLACKEN the string throughout so as to bring the scissors near the hand of the person holding the ends. Then work the loop, which is shown at the bottom of the figure, backwards along the double cord. You must be careful to make the loop follow the double cord on its course, in and out, until the loop is free of the scissors. Then pass the loop right

round the points of the scissors and follow the double cord backwards. The string will then, if you have been very careful, detach itself from the scissors. But it is important to avoid twists and tangles, or you will get it in a hopeless muddle. But with a little practice it may be easily done.

352.—LOCATING THE COINS

IF his answer be "even," then the shilling is in the right pocket and the penny in the left; if it be "odd," then the shilling is in the left pocket and the penny in the right.

353.—THE THREE SUGAR BASINS

THE number in each basin was originally thirty-six lumps, and after each cup had received two (one-eighteenth) every cup would then hold six, and every basin eighteen—a difference of twelve.

354.—THE WHEELS OF THE CAR

THE circumference of the fore-wheel and the hind-wheel respectively must have been 15 ft. and 18 ft. Thus 15 ft. goes 24 times in 360 ft., and 18 ft. 20 times—a difference of four revolutions. But if we reduced the circumference by 3 ft., then 12 goes 30 times, and 15 goes 24 times—a difference of 6 revolutions.

355.—THE SEVEN CHILDREN

THERE are 5,040 ways of arranging the children, and 720 different ways of placing a girl at each end. Therefore, the chances are 720 in 5,040, or 1 in 7. Or, which is the same thing, the chances

are 1 to 6 in favour, or 6 to 1 against, there being a girl at both ends.

356.—A RAIL PROBLEM

THERE must have been 51 divisions and 23 whole rails in every division. There were thus 1,173 whole rails, and 50 pairs of halves, making together 1,223 rails as stated.

357.—THE WHEEL PUZZLE

ALL you have to do is to place 10 in the centre and write in their proper order round the circle 1, 2, 3, 4, 5, 6, 7, 8, 9, 19, 18, 17, 16, 15, 14, 13, 12, 11.

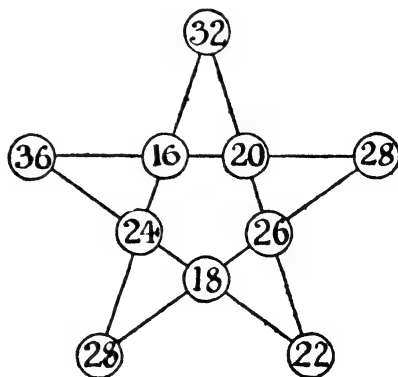
358.—SIMPLE ADDITION

ADD IV turned upside down below VI and you get X I.

359.—QUEER ARITHMETIC

ARRANGE 10 matches thus—F I V E. Then take away the 7 matches forming F E (seven-tenths of the whole), and you leave I V, or four.

360.—FORT GARRISONS



THE illustration shows one way of arranging the men so that the numbers in every straight line of four forts add up to one hundred.

The answer to the second question is: By immersing them in water and calculating from the rise of the water in the vessel.

361.—CONSTELLATION PUZZLE



HERE is a symmetrical solution in which the 21 stars form 11 straight lines, with five stars in every line.

362.—INTELLIGENCE TESTS

WHAT is wrong with the dream story is the obvious fact that, as the dreamer never awoke from his dream, it is impossible that anything could be known about it. The story must, therefore, be a pure invention.

363.—AT THE MOUNTAIN TOP

THE surface of water, or other liquid, is always spherical, and the greater any sphere is the less is its convexity. The spherical surface of the water must, therefore, be less above the brim of the vessel, and consequently it will hold less at the top of a mountain than at the bottom. This applies to any mountain whatever.

Perhaps some of our readers would like to give the full pros and cons to this problem.

364.—CUPID'S ARITHMETIC

ALL the young mathematician had to do was to reverse the paper and hold it up to the light, or hold it in front of a mirror, when he would immediately see that his betrothed's curious jumble of figures will read: "Kiss me, dearest."

40

40
38

50
28

15
2

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